Effect of Cattle Grazing near Streams, Lakes and Wetlands

A results-based assessment of range practices under the Forest Practices Code in maintaining riparian values

Special Report

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Summary

The Forest Practices Board has completed an assessment of the health of riparian areas subject to cattle grazing on Crown land across four forest districts in the southern half of British Columbia. Ten indicators of riparian health, or proper functioning condition, were measured at 391 sites in Cranbrook, Kamloops, Horsefly and Penticton districts. Half of the sites were on streams and half on wetlands and lakes.

Cattle lightly use the majority of riparian areas. Approximately 12 percent of riparian areas are heavily used based on our estimates of forage utilization. Overall, 71 percent of the sites are at proper functioning condition, 16 percent are functional at risk and 13 percent are non-functional. Significant differences were found between districts, with the percentage of sites at proper functioning condition ranging from 49 percent to 97 percent. The largest proportion of sites at proper functioning condition occurred in the moister biogeoclimatic zones, while the drier zones had the greatest proportion of non-functional sites. Riparian health scores and faecal counts in riparian areas were better in community watersheds than elsewhere. Individual pasture management was found to be a significant factor in maintaining riparian health.

These results indicate that a significant number of streams, lakes and wetlands are not functioning at an acceptable level, particularly in the drier areas in the interior of the province. While the unusually dry weather does influence this result, good range management practices could have avoided some of the impacts. This level of riparian impact is not acceptable to the public. As BC moves to results-based regulation, it is critical that the expected results for range practices are clearly defined and well understood by the ranching community so similar problems are avoided in the future.

Recommended changes include a clearer definition of proper functioning condition and a list of measurable criteria to determine it, development of a riparian classification system including a minimum width for defining riparian areas, expanding the scope of section 7(3) of the *Range Practices Regulation* to all riparian areas rather than just those in community watersheds, and adopting a maximum forage utilization standard in riparian areas. The Ministry of Forests is also advised to more clearly distinguish its roles and responsibilities in range use planning from those of the licensees.

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Background

The Forest Practices Board has conducted audits, complaint investigations and special projects on forestry practices over the past five years, but it has not yet examined range practices in detail. Some recent complaint investigations by the Board, as well as a survey of small streams in the central interior (Chatwin et al, 2001) indicate that some level of impact to riparian and stream habitats may be caused by cattle grazing.

In order to address this gap, the Forest Practice Board undertook both an audit and a special report in 2001. The audit—of range activities in Horsefly Forest District—examines compliance by range licensees and enforcement by government of the Forest Practices Code. The results of the audit will be reported under separate cover. This special report is a broader assessment, across a number of forest districts, of the current health of riparian areas where livestock grazing is the primary land use. It also examines the effectiveness of the Forest Practices Code in maintaining riparian health in areas subject to livestock grazing.

Validation of range practices, particularly riparian practices around streams, lakes and wetlands, is a high priority for resource managers. The unique values of riparian areas for maintenance of water quality, stream channel stability, and fish and wildlife habitat are well documented (Bunnell, 1992). Riparian areas also provide important watering sites for livestock and contribute significantly to livestock forage. However, the recent reports of the Provincial Health Officer (2001) and the Auditor General (1999) both cite livestock grazing as potential hazards to water quality. Grazing-related impacts can also be a factor in stream channel stability and loss of fish habitat (Buckhouse, 2001). Furthermore, many of the at-risk and endangered plant and animal species of the provincial grasslands are found in riparian areas (Bunnell, 1992). As a result, riparian areas are often the focus of range management planning and are usually given special consideration when developing range use plans.

Riparian areas in rangelands have legislated measures for protection different from areas proposed for forest harvesting. There is no requirement for stream, lake or wetland classification or designation as a fish stream. Riparian reserves, in which practices are prohibited, are not required. There are no prescribed riparian management zone widths. Rather, vegetative bandwidths define the riparian area.

In spite of these differences, the objectives for riparian management areas on rangelands, as stated in the *Riparian Management Area Guidebook* (RMA Guidebook), are similar to those for forestland. Range use practices meet riparian objectives when they maintain "proper functioning condition" (PFC) of each riparian habitat unit. The components of PFC form the basis of the assessment procedure used in this study.

Goals and Scope

This report is an assessment of the condition of riparian areas in rangelands on Crown land and the effectiveness of the Forest Practices Code in protecting riparian values. The survey was conducted to determine what proportion of riparian areas in range pastures are at proper functioning condition (PFC), functional at risk (FR), and non-functional (NF). The project is a one-time assessment, looking at the present-day condition of riparian sites. It does not report on trends in seral stage development, or on other parameters requiring monitoring over time.

The survey focussed on the southern half of the province, south of Williams Lake. Nearly 400 sites were assessed in the Cranbrook, Kamloops, Penticton and Horsefly forest districts. The pastures selected for the study were ones where cattle grazing was the primary land use and where the impacts of other land uses were minimal.

The project addressed the following questions:

- To what extent are livestock using riparian areas?
- What is the current condition of riparian areas on rangeland?
- Do current Code requirements appear to be achieving the intent of the Code and are there missing components that may reduce the protection of these areas?

Range Management of Riparian Areas under the Forest Practices Code

The *Forest Practices Code of British Columbia Act*, the *Operational Planning Regulation*, and the *Range Practices Regulation* address riparian management on rangelands. Section 45(1) of the Act, "protection of the environment," specifies that: "a person must not carry out a forest practice that results in damage to the environment." A forest practice is defined in the Act to include range practices.

The *Range Practices Regulation* prohibits certain impacts in riparian areas, but only within community watersheds. Livestock use of riparian areas in community watersheds must not result in faecal deposits, trampling of vegetation, deposit of sediments or exposure of mineral soil to the extent that the district manager considers detrimental. There are no standards, however, for the district managers to use in their determination. Some guidance as to what constitutes detrimental levels is provided in the *Community Watershed Guidebook*, however the focus of this guidebook is on maintenance of water quality rather than riparian condition.

The range use plan is the main mechanism for managing grazing under the Forest Practices Code. The required contents of a range use plan are listed in the *Operational Planning Regulation* and the *Range Management Guidebook*. The *Operational Planning Regulation* (amended in September 2000) specifies that the district manager must give the following information to a person preparing a range use plan:

- strategies to address known resource features or sensitive areas; and
- strategies to achieve proper functioning condition in riparian areas.

The *Operational Planning Regulation* defines "proper functioning condition" to mean the ability of a stream, river, wetland or lake, and its riparian area, to:

- withstand normal peak flood events without experiencing accelerated soil loss, channel movement or bank movement;
- filter runoff; and
- store and safely release water.

The person preparing the range use plan must then ensure that the plan includes measures to implement the strategies required by the district manager.

Higher-level plans, which provide direction to the range use plan, may also state objectives for range management in riparian areas. For example, the Cariboo-Chilcotin Land Use Plan (CCLUP) specifies that riparian areas are to be managed for proper functioning condition and the *Riparian Management Area Guidebook* must be used as a guide for development of range use plans and range use in riparian areas.

The *Riparian Management Area Guidebook* and the *Community Watershed Guidebook* can be directly referenced in range use plans. The *Riparian Management Area Guidebook* states that range use in riparian areas should be consistent with the following objectives:

- Minimize or prevent impacts of range uses on stream channel dynamics, aquatic ecosystems and water quality of all streams, lakes and wetlands; and
- Minimize or prevent impacts of range use on the diversity, productivity and sustainability of wildlife habitat and vegetation adjacent to streams, lakes and wetlands.

In summary, the main mechanism in the Forest Practices Code for protection of riparian areas is the requirement to meet proper functioning condition. This is a 'results-based' approach to riparian management, in contrast to the more prescriptive or rules-based approach used in forestry management.

Approach

There are different approaches to evaluating the effect of livestock grazing, as managed under the Forest Practices Code, on the health of riparian areas. The best approach is to start with an intensive inventory of site conditions, documented site management history, and a full understanding of the riparian ecosystems against which to evaluate. In the absence of complete knowledge and understanding, the next best approach is to establish a network of key sites that are used as a standard of background conditions against which changes can be measured. Trends from the standard condition can then be established by repeated measurements over a prolonged time period.

Unfortunately, British Columbia lacks a network of key riparian sites on rangeland, so trends in riparian health cannot be determined at this time. An alternate approach is a one-time assessment of riparian health based on a comparison of present riparian condition against a template of what we expect the riparian area to look like when all components of the riparian system are properly functioning. The comparison is not against a riparian area in the absence of livestock, but is against an educated concept of a site with all physical and vegetative components of the riparian area functioning. This "comparison to natural templates" approach to impact assessment is also used in the

evaluation of forest harvesting impacts on stream channel stability, as described in the *Channel Assessment Procedure Guidebook* (Ministry of Forests, 1996).

This latter approach was used in this project. It provides a snapshot in time of the health of riparian areas, where the predominant land use is cattle grazing. It does not establish trends, but does establish present condition against a template defining proper functioning condition. In future, if these same geo-referenced sites are re-assessed, trends in riparian health can be determined. The method cannot detect changes in riparian condition through the years of the Forest Practices Code. It does, however, provide a broad-based survey of riparian health on rangeland, seven years after the Forest Practices Code came into effect.

Evaluating Proper Functioning Condition

The methods for evaluating proper functioning condition of riparian areas are still evolving. Some range use plans—for example those in Kamloops Forest District—include a list of indicators of PFC:

- overhanging stream banks
- stream shading from adjacent riparian vegetation
- adequate plant cover and healthy root mass
- adequate cover for wildlife
- light browsing on shrubs
- minimal soil disturbance from trampling
- minimal surface erosion
- good permeability of water into soils
- impact of livestock being light overall, or heavy only on a small portion of the habitat unit

The *Riparian Management Area Guidebook* states that PFC is maintained when the effects of range use on the riparian habitats are, on average, small and within the range of natural variability. PFC is also maintained where large impacts of range use occur in no more than a small portion of a given habitat unit. The *Riparian Management Area Guidebook* and the *Community Watershed Guidebook* both provide some target conditions for range use of stream wetland habitats to ensure maintenance of PFC. The target conditions include:

- Livestock should not destabilize stream banks or result in a change in stream channel form.
- Concentrated trampling (greater than 20 percent soil disturbance) should not occur along high value fish habitat.
- Shrub cover on stream banks should be at least 85 percent of natural.
- Range use should not result in excessive nutrient enrichment.
- Exposed mineral soil should be less than 5 percent of the riparian zone.

The Ministry of Forests has developed riparian function checklists for streams, wetlands and uplands. The checklists form part of the range manual and ministry training courses. The purpose of the checklists is to allow evaluation of a reach of a stream, lake or wetland to measure whether the riparian area is meeting PFC. By answering 17 questions with "yes," "no" or "intermediate" and then tallying the "yes" scores, an overall score for the riparian feature is calculated.

A more quantitative system for evaluating PFC has been co-developed by the Riparian and Wetlands Research Program (RWRP) at the University of Montana and the U.S. Bureau of Land Management (Hansen et al, 2000). This method has also been adapted by the Province of Alberta (Cows and Fish Program, 2001) and field-tested in BC. The RWRP method differs from the Ministry of Forests checklist approach in that the factors that contribute to PFC, such as abundance of deep-rooted vegetation or area in bare mineral soil, are measured and scored rather than just relying on the end condition (such as "is the channel stable?"). The RWRP procedure was the primary method used in this study and is described in the following section.

Both the RWRP method and the BC Ministry of Forests methods were used to evaluate each site and similar overall results were obtained (see Appendix 3 for a comparison).

Method

The method used in this project was to select 75 range pastures distributed across four forest districts and then use field indicators to assess the riparian health of the 391 streams, lakes and wetlands in those pastures. This sample size is sufficiently large to determine the percentage of sites that are meeting PFC. The survey is strictly an on-the-ground assessment of the riparian zones following grazing; it does not examine licensee compliance with or government enforcement of the Forest Practices Code.

Selection of study area

The forest districts selected for this survey are Cranbrook, Kamloops, Horsefly and Penticton districts. Horsefly is also the subject of a Forest Practices Board range compliance and enforcement audit. Together, the four districts provide a representative cross-section of the biogeoclimatic zones across the southern interior (Figure 1, page 13).

Selection of tenures

The initial selection of candidate tenures was based on obtaining a good geographical distribution and a variety of tenure sizes and biogeoclimatic zones. District range staff was consulted to assist in choosing a preliminary set of tenures for inclusion in the study. Approximately 30 candidate tenures were initially selected in each district, from which a sample set of 15 to 20 was randomly chosen for field assessment. A total of 75 tenures were assessed in the four districts.

Selection of pastures

In each selected tenure, a single pasture was selected (not random) for field assessment. The characteristics of the selected pasture are:

- representative of the overall tenure
- fully stocked based on allocated animal unit months (AUMs). This biases the sample somewhat in that it excludes pastures that were in a rest-rotation or were under stocked. There was insufficient sample size of rest-rotation pastures to include as a component of this study.

- contains a number of streams, lakes or wetlands. The survey was designed to cover riparian sites with a range of inherent risk. For example, the survey includes small, low-gradient streams with soft alluvial floodplains as well as steep, armoured, incised streams.

In choosing the pastures, we attempted to choose similar numbers of spring, summer and fall pastures for each district. However, this was not always possible. For example, Horsefly has just one grazing season, which stretches from the spring through to the fall. As a result, they do not have different pastures for different grazing seasons.

Pastures that were affected by a number of different land uses, such as recreation or forest harvesting, were also avoided. Excluding multi-use pastures helped avoid confusion between cattle related vs. other causes of riparian impact.

Pastures are considered the primary sampling unit. Where a pasture is too big to be a logical sample unit, then a watershed within the pasture becomes the sample unit. Watershed-based sampling took place on about 15 percent of the tenures.

Survey timing

Surveys were conducted immediately after the cattle were removed from the pasture in order to assess forage utilization and to better distinguish cattle vs. wildlife impacts. Field sampling took place over three time periods:

- Early June – evaluation of grassland spring pastures
- September – evaluation of summer pastures
- Late October – evaluation of fall and alpine pastures.

Field assessments of riparian health

The field assessment methods are based on the *Lotic Health Assessments: Riparian Health Assessment for Streams and Small Rivers* methodology from the Riparian and Wetland Research Program at the University of Montana (see also *Riparian Health Assessment Method* by Fitch et al, 2001).

The method visually estimates 10 characteristics of the riparian zone along a 100-metre transect that is representative of the stream reach or lake/wetland shore. The 10 riparian characteristics are termed *indicators* of riparian health. In this study, the method for assessing stream channel disturbance was modified from the RWRP methodology and a new indicator for upland condition was added. A description of the indicators and the field methods used for determining them are described below.

i) Stream surveys

Only streams that conform to the definition of a stream in the Forest Practices Code were surveyed. There was little information available on the fish-bearing status of the streams, and no fish inventory was conducted as part of this study.

Stream reaches were identified for every stream in the pasture using contour maps, aerial photos or helicopter overflight. A minimum of 100 metres of each stream reach was surveyed on the ground. For example, if the pasture contains 3 stream reaches, then a minimum of 300 metres of stream was surveyed. All survey measurements were made on one side of the stream only. Beginning points were randomly located but were at least 50 metres from fences or roads to minimize their influences on livestock movements.

The 10 indicators used to assess riparian health were:

Indicator 1 – Percent vegetative cover

Vegetative cover is the total canopy cover of trees, shrubs, forbs and grasses. It enables a riparian system to trap sediment, reduces the velocity of water moving over the floodplain and contributes to bank stability. The vegetative canopy cover mitigates raindrop impact and other erosive forces and reduces the rate of evaporation. Vegetative cover is also an attribute important to wildlife habitat within the riparian zone.

Percent vegetative cover was estimated for the riparian zone, as defined by vegetation boundaries, over the length of a 100-metre transect on one side of the stream. Cover was estimated for total vegetative canopy cover by comparison with standardized percentage cover cards.

Indicator 2 – Livestock-caused bare ground

Livestock-caused bare ground is exposed mineral soil resulting from the activities of livestock. Examples include cattle trails and wallows. Exposed soil is vulnerable to erosion, can contribute to stream bank erosion, reduces sediment entrapment, and provides an opportunity for invasion by weeds.

Percent area in livestock-caused bare ground was visually estimated over the area of the riparian zone along the 100-metre transect. As much as possible, care was taken to differentiate livestock-caused bare ground from wildlife-caused bare ground. The timing of the survey—immediately after livestock were removed from the pasture—helped differentiate the cause. Bare ground that was the result of drawdown of water around ponds during dry weather was not counted.

Indicator 3 – Noxious weeds

Noxious weeds are those weeds on the *BC Noxious Weeds List* and include for example, knapweed and hound's tongue. An abundance of invasive noxious weed species may indicate a disturbance or a degraded ecosystem. While some of these species may contribute to riparian function, their negative impacts reduce overall health.

Percent cover of noxious weeds was assessed by listing all noxious weed species at the site and estimating their cover class in the riparian zone over the length of the 100-metre transect.

Indicator 4 – Percent disturbance-increaser species

Disturbance-increaser species are native or introduced plants that are absent, or present in low numbers, in undisturbed habitats. Populations of these species can become more prevalent with certain kinds of disturbance, including grazing. Examples are Kentucky bluegrass and dandelions. These plants may indicate a trend away from PFC in riparian areas. Most of these species provide less soil-holding and sediment-trapping capability and less desirable forage and wildlife value than native species. Noxious weeds counted in the previous indicator are not reconsidered here.

Percent disturbance-increaser vegetation was assessed by listing all undesirable species and estimating their cover class in the riparian zone over the 100-metre transect.

Indicator 5 – Percent browsing of shrubs

Livestock and/or wildlife browse a variety of riparian shrub species. Excessive use of these species may cause them to be eliminated from the site and replaced by less desirable species. Browse utilization was estimated on both current-year and second-year growth. Second-year browse is more representative of the long-term impact that browsing is having on specific species of riparian shrubs. It was difficult to differentiate cattle vs. wildlife browse. However, with the exception of the Cranbrook district, wildlife use was probably not heavy at most sites.

Percent browsing of shrubs was estimated by plot transects at 10-metre intervals, where shrubs of preferred cattle browse species are selected. At each plot, browse utilization was estimated on both current-year and second-year growth. At each plot centre, representative plants of each species were selected and the total number of leaders and the total number of browsed leaders was counted and percentage utilization was calculated. The dominant browsed shrub species in each plot was also listed.

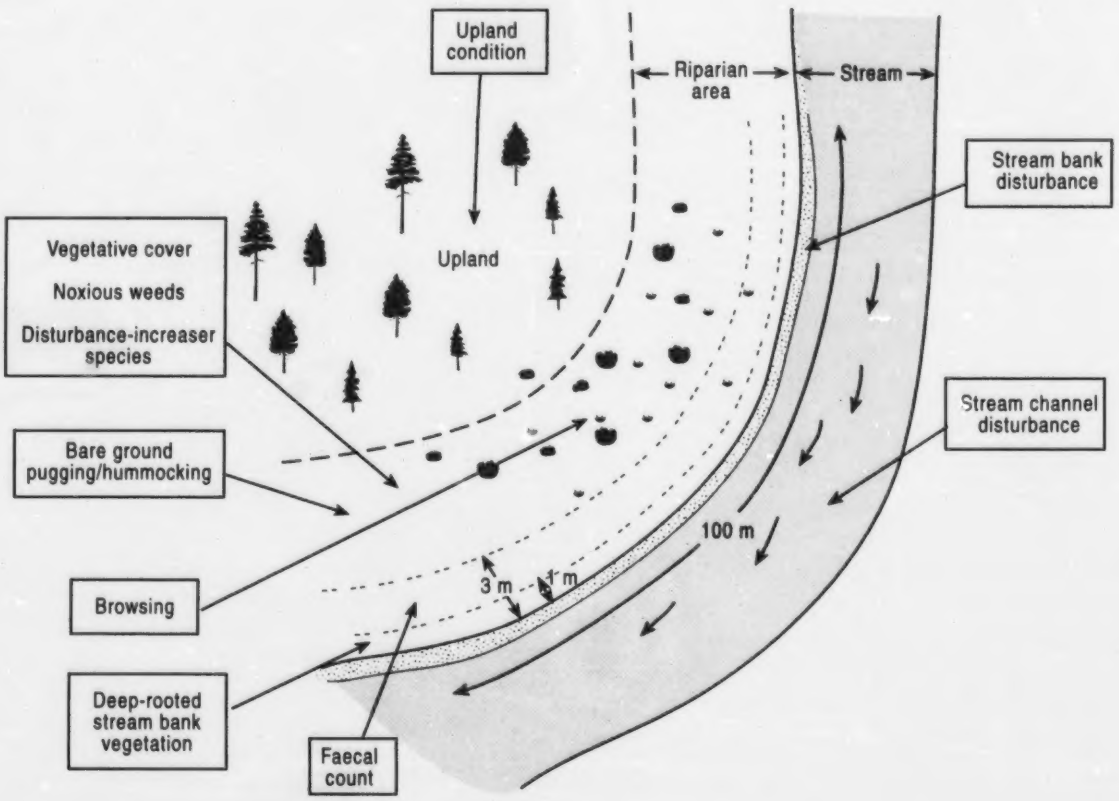

Diagram 1. Sketch showing the location in the stream channel or riparian area where the indicators were measured. Indicator values are averaged over a 100-metre reach.

Indicator 6 – Deep rooted stream bank vegetation

Streamside vegetation maintains the structure of the stream bank by resisting lateral scour or wave action, and by trapping sediment to build and restore banks. Vegetation with deep and binding roots best serves this function. Examples of deep-rooted stabilizing vegetation include trees, shrubs and sedges. Herbaceous species, such as Kentucky bluegrass, are often shallow-rooted and not effective in binding stream bank soils.

Percent stream bank root mass protection was visually estimated from the plant species growing in the stream banks (0–1 metre from the unvegetated stream bank edge) over the length of the 100-metre transect.

Indicator 7 – Stream bank disturbance

Stable stream banks maintain channel configuration and bank shape. When stream banks are physically disturbed, fluvial erosion can mobilize channel materials, water quality can deteriorate, and instability can increase within the reach and downstream. Bank disturbance can result from livestock hoof shear, livestock trails and crossing sites, and watering sites. Bank disturbance, as a result of timber harvest and recreation, as well as natural causes, were not included in the survey results. For most sites, the cause was obvious, but some error is inevitable.

Length of stream bank disturbance was inventoried by measuring 100 metres down the channel of the study reach and recording the location, length and severity of cattle-related bank disturbance. For this indicator, only moderate and high severity bank disturbance was counted in determining the percentage of the bank altered.

Indicator 8 – Channel bed disturbance

A channel bed adjusted to its flow regime provides an armoured bed, resisting scour and structural elements such as woody debris that dissipate energy and provide fish habitat. Direct channel bed impacts from livestock can include trampling, pugging and churning of stream bed sediment, infilling of pools with sediment and disturbance of woody debris, which can affect the channel morphology.

In this study, the RWRP method for assessing channel bed disturbance was modified to follow the methodology described in the *Channel Assessment Procedure: Field Guidebook* (Ministry of Forests, 1996). Length of channel bed disturbance was inventoried by measuring 100 metres of the reach and recording the location, length and severity of cattle related bed disturbance. Only moderate and high-severity bed disturbance was counted in determining the proportion of the channel bed altered.

Indicator 9 – Pugging and hummocking

Moist, fine-textured soils are very susceptible to soil degradation by hoof damage. Pugging and hummocking refers to the alteration of riparian soils by the hoof action of livestock. Clay or silt soils have the consistency to puddle, compact and hold animal tracks (or pugs). Extensive pugging compacts and exposes mineral soil to erosion, reduces the structure and water-holding capacity of the soil and disrupts normal plant succession. Hummocking is the micro-relief characterized by raised pillars of soil and is the residual soil surface as a result of pugging.

Percent of pugging or hummocking was estimated as a percent occurrence of the riparian zone over the 100-metre transect. Hummocking due to livestock was distinguished from hummocking due to frost action. Exposed mineral soil due to pugging and hummocking was not included in the bare mineral soil of indicator 2.

Indicator 10 – Upland condition

An upland condition indicator was added to the RWRP list of indicators. Upland sites were surveyed only where livestock disturbance could affect riparian sites or impact water quality. For example, if the adjacent upland was heavily forested on a 5 percent slope with light utilization, then a formal site assessment was not completed. The following information was collected:

- percent vegetative cover
- percent livestock-caused bare ground
- percent utilization
- slope
- ability of water to infiltrate the soil
- channel stability of ephemeral drainages
- evidence of surface erosion (pedestals, rills, etc.).

The rating of upland condition was a subjective evaluation into low, moderate, high or very high hazard classes based on the above observations.

In addition to the 10 riparian health indicators described above, two additional characteristics of the riparian zone were also measured:

- *Percent forage utilization* was visually estimated over the length of each 100-metre transect by comparison of the heights of plants in grazed areas with ungrazed plants.
- *Number of cattle faeces* was counted in a 3-metre band parallel to the stream bank, on one side of the stream, over the 100-metre transect.

ii) Wetlands and lakes surveys

Within the pasture, 70 to 100 percent of all mapped wetlands and lakes were assessed. Wetlands smaller than 0.1 hectares are usually not mapped, so were not assessed. Transects cover a representative 100 metres of lake/wetland shoreline. If there was a distinctive change in topography or vegetation around the shoreline, then a second transect was completed. Using similar methods, 8 of the 10 health indicators used for streams were also collected for wetlands and lakes:

- percent vegetative cover
- percentage of livestock-caused bare ground
- percent cover of noxious weeds
- percent cover of increaser-invader vegetation
- browsing of shrubs (percent utilization)
- percent of shoreline with deep-rooted vegetation
- length of shoreline disturbed by livestock
- percentage of riparian area with pugging or hummocking.

Determining riparian health

After field measurements were completed, the value recorded in the field for each individual indicator was converted to a score. The scoring system (Table 1) is based on research conducted over thousands of sites at the University of Montana (Hansen et al, 1995). Threshold values for each indicator are specified, which indicate whether the indicator value is below a functional at risk (FR) level or at a non-functional level (NF).

The various indicators are scored differently, depending on their relative contribution to riparian health. For example stream bank disturbance is more significant than pugging and hummocking. Lower scores are also assigned to indicators where there are possible other causes, for example browsing which may be affected by wildlife.

Table 1. Thresholds and scores for the riparian indicators

Indicator	PFC		FR	NF
Vegetative cover	>95%	85–95%	75–85%	<75%
Score	6	4	2	0
Livestock-caused bare ground	<1%	1–5%	5–10%	>10%
Score	6	4	2	0
Noxious weeds	<1%	1–5%	5–20%	>20%
Score	3	2	1	0
Increaser-invader species	<5%	5–25%	25–50%	>50%
Score	3	2	1	0
Browsing	0–5%	5–25%	25–50%	>50%
Score	3	2	1	0
Deep-rooted stream bank vegetation	>85%	65–85%	35–65%	<35%
Score	6	4	2	0
Stream bank disturbance	<5%	5–15%	15–35%	>35%
Score	6	4	2	0
Channel bed disturbance	<5%	5–15%	15–35%	>35%
Score	6	4	2	0
Pugging/hummocking	<5%	5–15%	15–25%	>25%
Score	3	2	1	0
Upland condition	VL	L	M	H
Score	3	2	1	0

By adding the scores for all the indicators, an overall riparian health score can be calculated. The overall riparian health score is expressed as a percentage of the maximum possible score of 45 points. For example, a site scoring 40 points would have a riparian health score of 40/45 = 89 percent. This percentage score is then used to determine if the site is at proper functioning condition (Table 2). At 89 percent, the example site would be considered to be at proper functioning condition.

Table 2. Determining proper functioning condition

Riparian Health Score	Rating
>80 percent	Proper functioning condition
60–80 percent	Functional at risk
< 60 percent	Non-functional

Results

Distribution of sites

A total of 391 riparian sites were surveyed across four forest districts (Table 3). Distribution of wetland/lakes (187 sites) and streams (204 sites) was relatively even across the individual districts and across the total geographic area.

Table 3. Number of sites in each district

Location	# Streams	# Wetlands	Sub Total
Cranbrook	43	59	102
Horsefly	43	44	87
Kamloops	29	46	75
Penticton	89	38	127
Overall	204	187	391

Most streams in the sampled pastures were 1 to 3 metres in width, with the range between 0.5 and 10 metres. Wetland and lake sites included lakes, marshes, fens, swamps, wet meadows and bogs. The majority of the wetland/lake sites were in the 1 to 5 hectare class.

The survey covered nine biogeoclimatic zones (Figure 1). The largest number of sites (40 percent) was in the interior Douglas-fir (IDF) zone. Only five pastures were surveyed in the bunchgrass zone (BG), as most bunchgrass range is located on private land. The remaining surveyed sites were distributed over the ponderosa pine (PP), montane spruce (MS), subboreal spruce (SBS), subboreal pine spruce (SBPS), interior cedar hemlock (ICH), and Engelmann spruce-subalpine fir (ESSF) and alpine tundra (AT) zones.

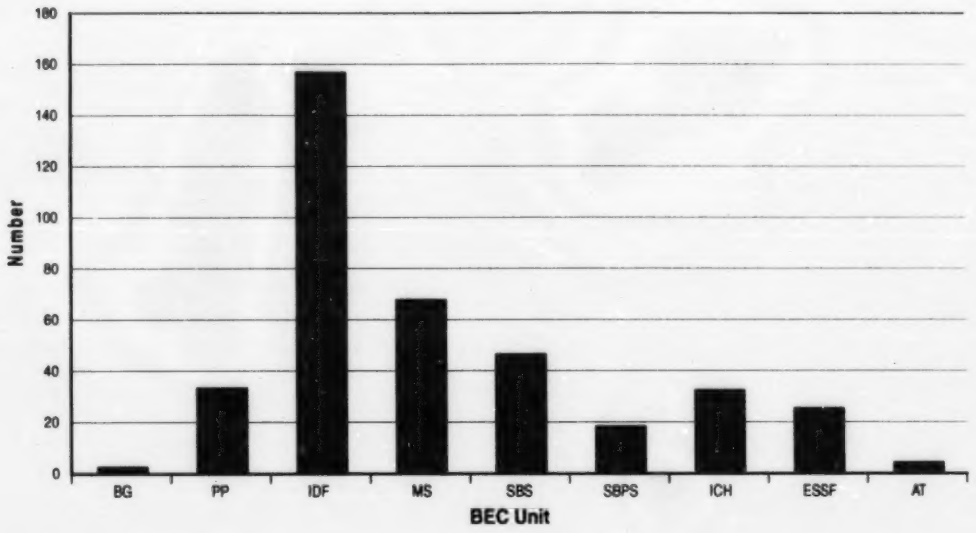

Figure 1. The number of sites in each biogeoclimatic (BEC) zone.

Use of riparian areas

Measurements of forage utilization can be used to estimate the relative use of riparian areas by livestock in the current year. Forage utilization can be estimated by determining the percentage of the standing crop of grasses and herbs grazed by livestock. Utilization is not a measure of riparian health, however, because forage use in a single year may have little impact on the long-term ecological function of a riparian system. The *Riparian Management Area Guidebook* recommends maximum utilization rates of 50 to 70 percent, depending on plant species. Range use plans usually prescribe a maximum 50 to 65 percent forage use in riparian areas.

In our survey, 65 percent of the total sites had utilization levels under 5 percent. On 88 percent of the sites, forage utilization was under 50 percent (Figure 2). Six percent of the sites had utilization in excess of 75 percent.

The number of sites with greater than 50 percent utilization was unevenly distributed between districts (Figure 3). In the Cranbrook district, 23 percent of wetlands and 31 percent of stream sites had utilization levels greater than 50 percent. Kamloops and Penticton had 17 percent of the wetlands utilized to more than 50 percent. Except in Cranbrook, forage utilization exceeded 50 percent on less than 10 percent of the stream sites.

We conclude that, on average, cattle lightly use the majority of riparian areas. These are generally the more heavily forested riparian areas. Approximately 12 percent of the riparian areas are heavily or intensively used; these are generally the grassland, parkland and open forest sites, particularly around wetlands. In Cranbrook district, which was subject to a very dry year, utilization of riparian areas was more pronounced with up to 30 percent of the sites with riparian utilization in excess of 50 percent.

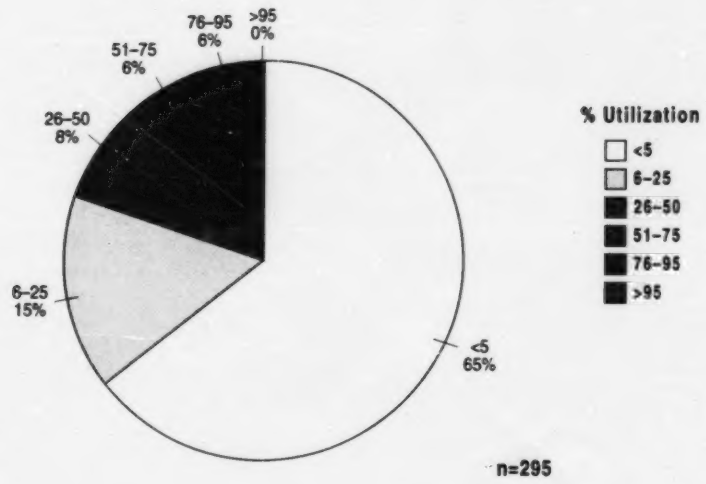

Figure 2. Percentage of sites by forage utilization of riparian vegetation.

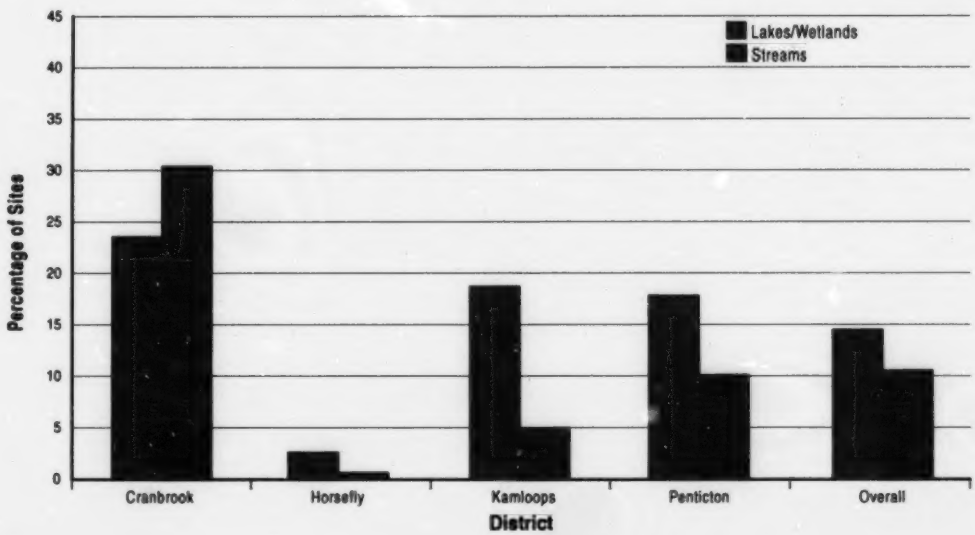

Figure 3. Percentage of sites with riparian vegetation utilization greater than 50%.

Indicators of riparian health

Riparian health was based on the 10 riparian indicators measured at each stream site and the 8 indicators measured at each lake/wetland site. The indicators were measured in the field and then scored using Table 1, as previously described.

A comparison between average indicator scores shows which riparian attributes are functional and which are not. The average score for each indicator, expressed as a percentage of the maximum

possible score for all 391 sites, is graphed in Figure 4. The distribution of raw values measured for each indicator, for all 391 sites, is graphed as a pie chart in Appendix 1 (Figures A1 to A20).

The average score for each indicator is calculated separately for wetlands and for streams (Figure 4). For example, the pugging and hummocking indicator averages 65 percent for lakes/wetlands and 85 percent for streams.

The triangle and cross symbols on the bars in Figure 4 also show the percentage of the sites that scored below the proper functioning condition threshold. For example, for the pugging and hummocking indicator, 30 percent of wetlands and 10 percent of streams scored below the PFC threshold. Appendix 1 also illustrates, separately for each district, the percentage of sites that did not meet the proper functioning condition level for that indicator.

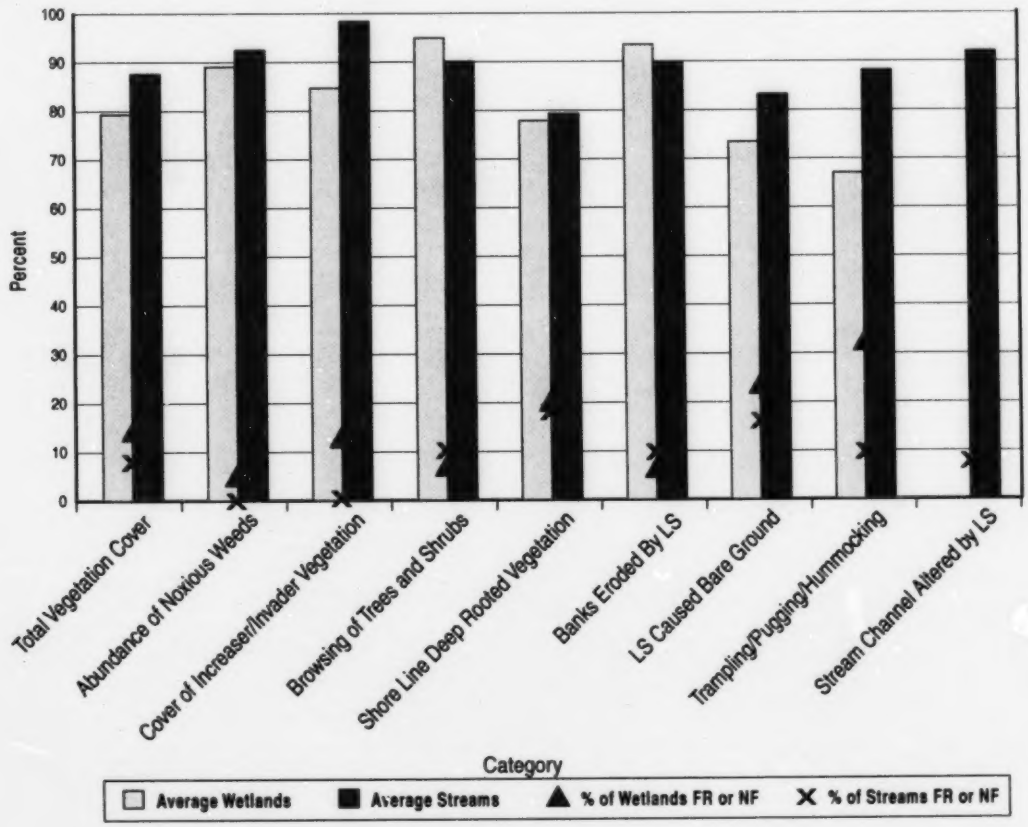

Figure 4. Average percentage scores for each indicator and percent of sites at FR or NF for that indicator.

The average scores for the indicators fall into three categories (Table 4) of impacts: low impact, intermediate impact and high impact.

Table 4. Low, intermediate and high impact indicators

Low Impacts	Intermediate Impacts	High Impacts
Noxious weeds	Vegetative cover	Livestock-caused bare ground
Increaser-invader species	Stream bank disturbance	Pugging and hummocking
Browsing of shrubs		Deep-rooted vegetation
Channel bed disturbance		

Overall the lowest impacts were measured for indicators for noxious weeds, increaser-invader species, browsing of shrubs and channel bed disturbance. On average, these indices scored over 90 percent and had less than 10 percent of the sites below the PFC threshold. By contrast, the indicators for livestock-caused bare ground, pugging and hummocking and deep-rooted vegetation recorded the highest impacts to riparian health. These three indicators scored less than 80 percent and with more than 20 percent of the sites below the PFC threshold. Intermediate impacts to riparian health were recorded for the vegetation cover and the stream bank disturbance indicators.

Overall riparian health scores

The overall riparian health score is an integration of the 10 (stream) or 8 (lake/wetland) individual riparian indicator scores into a single score of overall riparian health for that site. Overall riparian scores were calculated for each of the 391 sites by summing the 10 indicator scores and expressing the total as a percentage of the maximum possible sum. These scores were also calculated separately for streams and for wetlands in each district (Figure 5).

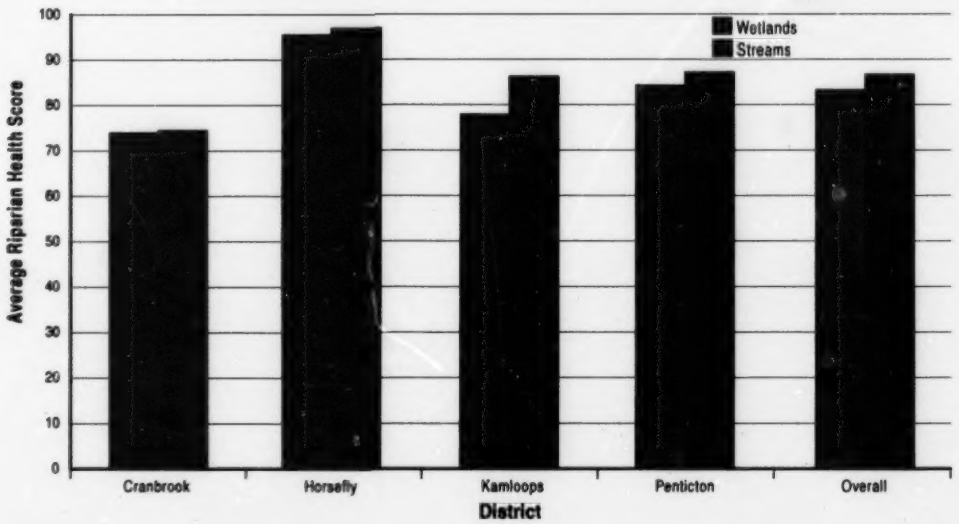

Figure 5. Average riparian health score by district.Scores of greater than 80 percent are considered at proper functioning condition, while scores of 60 to 80 percent are considered functional at risk and scores of less than 60 percent are considered non-functional.

Based on all 391 sites surveyed, both wetlands and streams are, on average, at proper functioning condition. Averaged scores for wetlands and for streams were quite similar within each district. The highest averaged riparian scores are Horsefly streams and wetlands (greater than 95 percent, Figure 5). Kamloops streams and Penticton wetlands and streams averaged 80 to 90 percent, while Cranbrook streams and wetlands and Kamloops wetlands averaged 70 to 80 percent.

Although the average condition of the riparian sites met the criteria for proper functioning condition, a number of individual sites were NF or FR (Figure 6). Overall, 71 percent of the sites are PFC, 16 percent are FR and 13 percent are NF. Streams and wetlands at non-functional condition ranged from 30 percent in Cranbrook to 0 percent at Horsefly. Streams functional at risk ranged from 29 percent in Cranbrook to 4 percent in Horsefly. Finally, wetlands functional at risk ranged from 17 percent in Cranbrook to 2 percent in Horsefly.

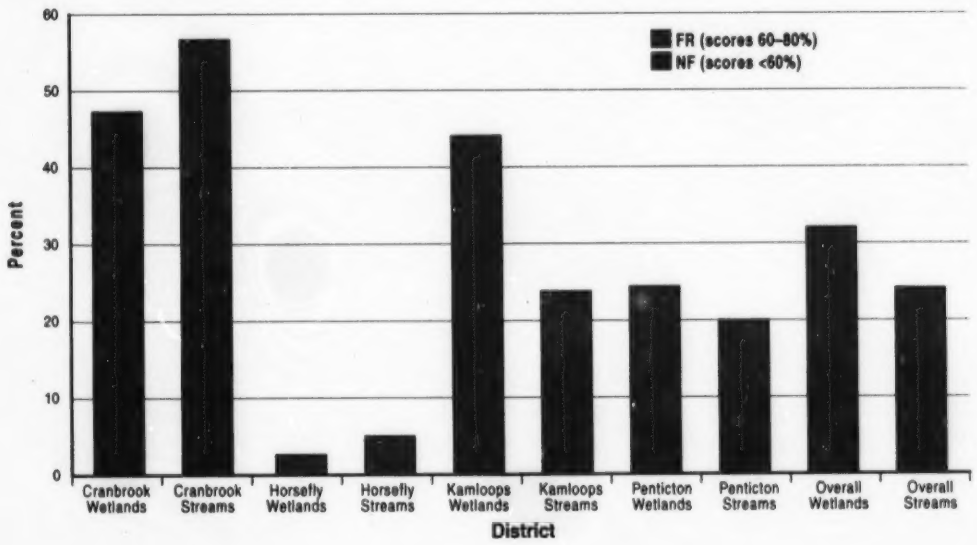

Figure 6. Percent of features at FR or NF.

Riparian health in community watersheds

Community watersheds cover 15 to 20 percent of the Kamloops, Penticton and Cranbrook forest districts. Within these drinking water source areas, a higher standard of grazing management to protect streams and water quality is expected (*Community Watershed Guidebook*, 1995).

This survey included 41 sites (29 streams and 12 lakes) within community watersheds in Kamloops and Penticton districts. No community watershed sites were surveyed in the Horsefly and Cranbrook districts.

Riparian health scores for sites within community watersheds were compared with sites outside of community watersheds in Kamloops and Penticton districts. Three measures were used: the average riparian health scores, the percentage of sites not at proper functioning condition, and the number of cattle faeces within a specific portion of the riparian zone. The riparian health score is comprised of a

number of indicators that can affect the amount of suspended sediment during runoff events. Suspended sediment affects water quality and impedes water treatment. A low riparian score indicates an increased risk of suspended sediment beyond natural levels during runoff. Cattle faeces was counted, as it can impact water quality by affecting nutrient levels and bacteriological counts.

The number of cattle faeces was counted in the water and in a 3-metre band parallel to the stream or wetland/lake shore over the 100-metre transects. Counts were restricted to this band, as studies have shown that faecal material generally does not significantly enter a water body at distances greater than 3 metres (Buckhouse, 2001). The *Range Practices Regulation* states that in community watersheds, "livestock use of riparian areas must not result in faecal deposits, trampling of vegetation, deposit of sediments or exposure of mineral soil to the extent that the district manager considers detrimental." There is no absolute measure, however, for the amount of faecal deposits considered detrimental.

Community watershed riparian sites in a combined Kamloops and Penticton data set scored significantly better than non-community watershed sites in those same districts (Table 5 and Table 6). The faecal counts for all of the districts are shown in Appendix 2. Community watershed streams averaged 1 cattle faeces per 100 metres of stream bank, while non-community watershed streams averaged 4.5 cattle faeces per 100 metres of stream bank. Lakes and wetlands averaged 2.5 cattle faeces per 100-metre transect in community watershed sites and 9 in non-community watershed sites. Combining lake and stream sites, the cattle faeces count was 1.4 in community watersheds and 8 in non-community watersheds. The maximum cattle faeces counted in any community watershed site was 15 and in non-community watershed sites was 120.

Table 5. Average numbers of cattle faeces in a 3 m × 100 m band

	Lakes	Streams	Combined
Community watersheds	2.5	1.0	1.4
Non-community watersheds	9.0	4.5	8.0

The overall riparian health score was also better in community watersheds (Table 6). The combined stream and lake average riparian health scores for community watershed sites was 90 percent, while for non-community watersheds the average score was 83 percent. The percentage of sites that were not at proper functioning condition was 7.5 percent in community watersheds and 26 percent in non-community watersheds. Only one community watershed site was found to be NF.

Table 6. Summary of riparian indices in community watersheds

	Average cattle faeces	Average riparian score	Not at PFC
Community watersheds	1.4	90%	7.5%
Non-community watersheds	7	83%	26%

Our conclusion, based on the limited sample in the two districts, is that riparian health and faecal counts inside of community watersheds is better than in non-community watersheds. However, there are no established criteria or baseline information against which to assess riparian health or established measures to indicate whether or not the condition of riparian areas found in this assessment is acceptable.

Factors Influencing Riparian Health

The data was examined to see if there was a relationship between zonal climate or individual pasture management and riparian health.

Zonal climate

We examined how overall riparian health varied by biogeoclimatic zone (BEC). Sampling took place across 9 biogeoclimatic zones with 5 to 150 sites in each zone.

There are differences between the average overall score for each BEC zone (Figure 7). The BEC zones are arranged left to right from dry, low elevation zones to wetter, high-elevation zones. In general, the drier zones (PP and IDF) have lower average scores, the moist zones (MS) have intermediate scores and the wetter zones (SBS, ICH and ESSF) have the highest average scores.

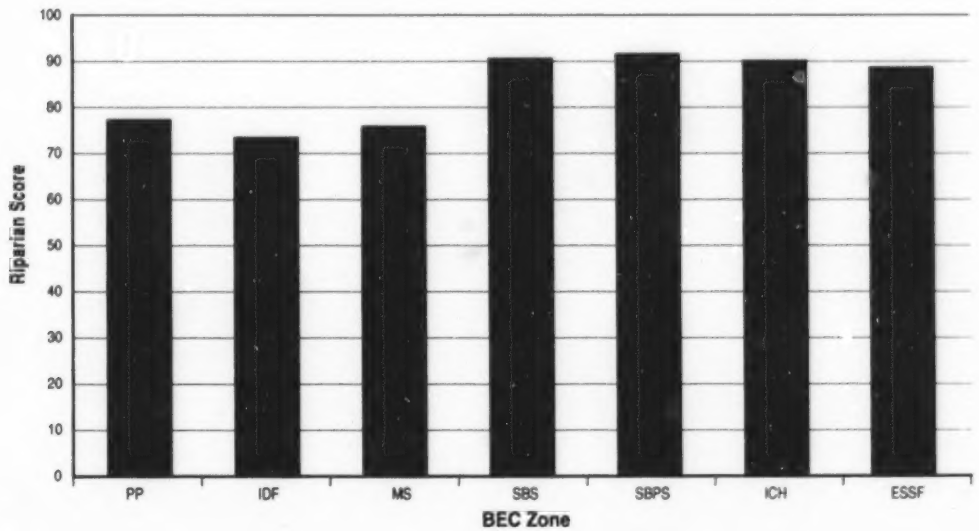

Figure 7. Overall riparian score by BEC zone.

The percentage of sites functional at risk or non-functional follows a similar pattern (Figure 8). In the drier zones (PP, IDF and MS) 30 to 40 percent of the sites were FR or NF, while in wetter zones (SBS, SBPS, ICH and ESSF) very few sites were NF and less than 10 percent were FR.

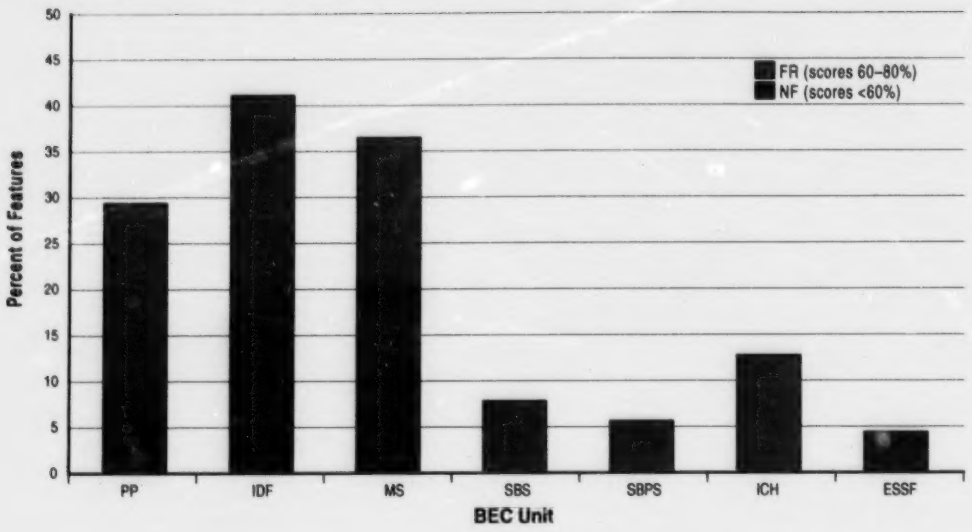

Figure 8. Percent of features at FR or NF, arranged by BEC zone.

Drier ecosystems have more FR and NF sites for a number of possible reasons. Water is scarce on many of these pastures, and often poorly distributed, leading to cattle using the available areas more intensely. Late in the summer, there can be marked differences between forage on riparian and adjacent upland sites in the drier zones. Riparian areas often provide more succulent and palatable forage than the uplands near the end of the grazing season, and they can be heavily utilized during this period.

Influence of individual pasture management

Pasture management can affect riparian health by controlling the grazing schedule and stocking rate as well as through range practices such as salting. We examined the possible influence of pasture management by determining the variance in the average riparian health score for all of the sites examined in the individual pastures. If pasture management was not an important factor in riparian health, then we expect a low level of variance between the average riparian scores for each pasture within the same biogeoclimatic zone within each district. By contrast, if pastures in the same district have very different riparian health scores, then individual pasture management is probably an important factor.

We only considered pastures that had six or more riparian sites and were within the IDF biogeoclimatic zone for this analysis. Examining sites within one biogeoclimatic zone will reduce confounding effects due to zonal climate. Differences between pastures, such as distribution of water and topography, can also affect the results and these differences were not accounted for.

The percentage of riparian sites within each pasture that were rated as FR or NF was highly variable, ranging from 0 to 100 percent. Figure 9 shows the results for a selection of pastures in three districts, which illustrates the range of results.

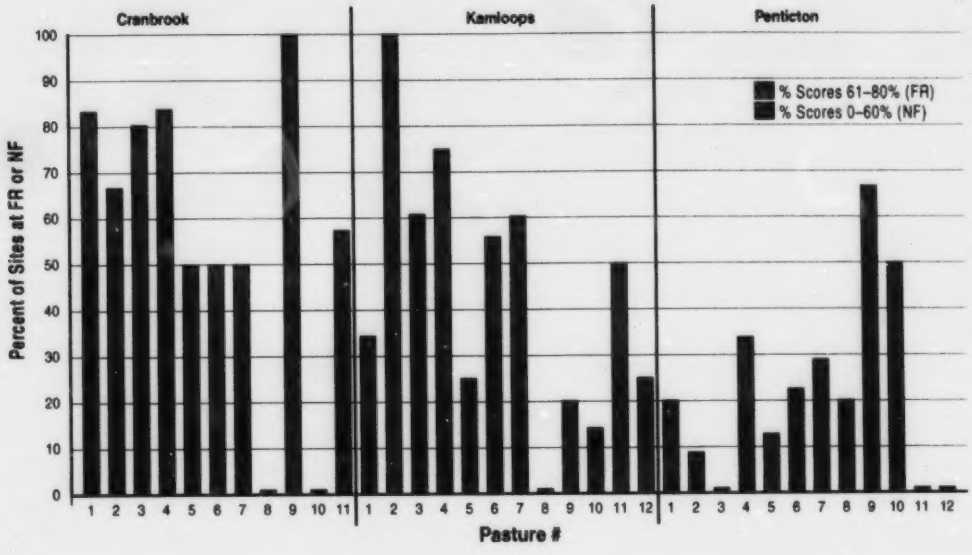

Figure 9. Percentage of sites in individual pastures that are FR or NF.

In some cases, 100 percent of the sites within a pasture were NF or FR, while another nearby pasture had 0 percent NF or FR sites. The large differences between the number of FR and NF sites between pastures within the same district means that individual pasture management may be a significant factor in affecting riparian health.

Conclusions

This special project set out to address the following questions:

- To what extent are livestock using riparian areas?
- What is the current condition of riparian areas on rangelands?
- Do current Code requirements appear to be achieving the intent of the Code and are there missing components that may reduce the protection of these areas?

To what extent are livestock use riparian areas?

We conclude that, on average, cattle lightly use the majority of riparian areas. These are generally the forested riparian areas. Approximately 12 percent of the riparian areas are heavily or intensively used. These are generally the grassland, grassland openings and open forest sites, particular around wetlands. Utilization of riparian areas varies by district; in the moist, heavily-forested Horsefly district, no sites recorded heavy utilization: whereas in Cranbrook district, which was subject to a very dry year, utilization of riparian areas was more pronounced with up to 30 percent of the sites with riparian utilization in excess of 50 percent.

What is the current condition of riparian areas on rangelands?

We measured 8 to 10 riparian health indicators at 391 sites across 4 forest districts and 9 biogeoclimatic zones to determine the overall health of the riparian ecosystem, as affected by cattle grazing.

Overall, the average score for riparian health is 86 percent, but there are also a significant number of impacted sites. Across the four districts, wetlands averaged 85 percent and streams averaged 87 percent. However, there are significant differences in average scores between districts. In the Horsefly district, wetlands and streams combined averaged better than 95 percent. Kamloops streams and Penticton wetlands averaged 80 to 90 percent, while Cranbrook streams and wetlands averaged 70 to 80 percent. Scores of less than 80 percent do not meet proper functioning condition.

The main conclusions of this study relate to the number of sites found to be at proper functioning condition (Table 7):

Table 7. Number of sites at PFC

District	Proper Functioning Condition	Functional at Risk	Non-functional
Cranbrook	49%	21%	30%
Kamloops	66%	17%	17%
Penticton	80%	12%	8%
Horsefly	97%	3%	0%
All 4 Districts	71%	16%	13%

Seventy-one percent of the sites surveyed are at proper functioning condition. The largest proportion of these sites is in the Horsefly district and in the moister biogeoclimatic zones of the other three districts surveyed.

Sixteen percent of the sites were functional at risk. Most of these sites are near proper functioning condition, but there is room for improved management to achieve PFC on these sites. Thirteen percent of the sites were non-functional. These sites were often in the drier ecosystems in the Cranbrook, Penticton and Kamloops districts.

Riparian sites in the wetter biogeoclimatic zones are generally in better condition than the drier zones. In the drier zones (PP, IDF and MS), 30 to 40 percent of the sites were FR or NF, while in the wetter zones (SBS, SBPS, ICH and ESSF) few sites were NF and less than 10 percent were FR.

The reader is again cautioned that these results are based on a sample, not a complete inventory of all riparian areas, and is a one-time assessment. Therefore, it does not look at the trend of the site. Some sites may be improving, or others deteriorating, from their present condition.

Do current Code requirements appear to be achieving the intent of the Code and are there missing components that may reduce the protection of these areas?

The *Forest Practices Code of British Columbia Act*, the *Operational Planning Regulation*, and the *Range Practices Regulation* address riparian management on rangelands.

Forest Practices Code of British Columbia Act

Section 45(1) of the Act, "protection of the environment," specifies that: "a person must not carry out a forest practice that results in damage to the environment."(A forest practice is defined to include range practices).

Clearly, damage to the environment includes damage to riparian areas. The results of this survey show that the majority of riparian areas were at proper functioning condition, but 13 percent were non-functional and 16 percent were functional at risk. One district had 30 percent non-functional sites. It is important to clarify that the definition of PFC recognizes that livestock grazing cannot be carried out with zero alteration of the riparian zone. In spite of the level of impact found in this assessment of range practices, to our knowledge, there has been no enforcement action taken under section 45 of the Act.

There are two limitations to taking enforcement action under section 45. A licensee is exempt from section 45(1) if he is acting in accordance with an operational plan such as the range use plan. Under the new process for producing range use plans, the rancher is responsible for specifying the measures that will be used to achieve the objectives and strategies specified by the district manager in the plan. As the grazing schedule is the main measure specified in the range use plan for limiting grazing impact, it is possible—particularly in dry years—for the rancher to be in accordance with the range use plan but still cause damage to the environment.

Section 45(3) is intended to cover situations of gross damage that may result, in spite of conforming to the operational plan. It states: "A person must not carry out a forest practice if he knows or should know, that due to weather conditions or site factors, the carrying out of the forest practice may result in inordinate soil disturbance." This section does not apply to range practices, however, as it applies only to soil disturbance limits in a cutblock as specified in a silviculture prescription. Application of this section to range activity seems appropriate but may be impractical, as it would require an expanded definition of soil disturbance. Soil disturbance limits in riparian areas would also have to be specified in the range use plan.

Definition of riparian area

Riparian area is defined in the *Operational Planning Regulation* and the *Range Practices Regulation* as an area of land that:

(a) is adjacent to a stream, river, lake or wetland, and

(b) contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland area

Riparian areas do not have a specified minimum width, as riparian management areas do in forestry. Many of the streams and lakes surveyed did not have distinctive riparian vegetation, as described in the definition. Along incised streams or sloping lakeshores, terrestrial vegetation often extends to the stream bank or lakeshore. By the Code definition, there is no riparian zone, and the provisions in the regulations do not apply.

There is, however, a zone of riparian influence on these streams and lakes. Range activities that result in exposure of mineral soil, pugging, erosion of stream banks and shorelines or replacement of native vegetation with less desirable species, can affect water quality, fish habitat and stream channel stability

regardless of the vegetation type in the riparian area. The riparian area should have a minimum width of either a specified distance, or the outer edge of hydrophytic vegetation: whichever is greater.

The *Range Practices Regulation*, section 7(3)

Section 7(3) of the *Range Practices Regulation* prohibits certain impacts in riparian areas, but applies only to community watersheds:

> "A holder of an agreement under the *Range Act* must not allow livestock use in a riparian area of a community watershed if the use would result in faecal deposits, trampling of vegetation, deposit of sediments or exposure of mineral soil to an extent that the district manager determines to be detrimental."

It is not clear why this regulation applies only to community watersheds, as its objective of prohibiting direct damage to riparian areas is more widely applicable. Further, without a clear and measurable standard for faecal deposits and soil exposure, enforcement of the regulation is difficult and highly subjective. It is not appropriate to leave the criteria for these impacts to the discretion of district managers.

The Range Use Plan

Under the *Operational Planning Regulation*, a required content of a range use plan is to specify strategies and measures to achieve or maintain proper functioning condition in riparian areas. This is the main mechanism used to regulate range activity in riparian areas.

A number of issues arise from this objective-setting approach to riparian management:

1. Defining proper functioning condition

The *Operational Planning Regulation* defines "proper functioning condition" to mean the ability of a stream, river, wetland or lake, and its riparian area, to

- withstand normal peak flood events without experiencing accelerated soil loss, channel movement or bank movement;
- filter runoff; and
- store and safely release water.

This definition is open to interpretation. For example, the definition provides no criteria for determining whether the riparian zone can filter runoff or safely release water. Some districts, such as Kamloops, have attempted to improve the definition by specifying a list of criteria for determining PFC in the range use plan, but most districts have not. The Ministry of Forests range manual further describes what is meant by PFC and provides a checklist of PFC attributes, but this policy manual has no legal status under the Code.

Without clear criteria for determining PFC, the field methodology that is chosen can influence the outcome, which is clearly unacceptable. To illustrate this point, all of the riparian sites assessed in this study using the riparian health score method were also assessed using the Ministry of Forests' PFC checklist method (see Appendix 3). The majority of sites were similarly rated, but there were a significant number of discrepancies (Table 8).

Table 8. Comparison of two methods of determining PFC

	This Study	MOF PFC Checklist
% proper functioning condition	71%	75%
% functional at risk	16%	20%
% non-functional	13%	5%

In a results-based code, the standards for PFC must be clear (not open to interpretation by different parties) and auditable (stand up to repeated measurement). If a results-based Code is to provide the legal standards against which performance by a party will be measured, then the standard must include not only targets to be achieved, but it must also specify the minimum standard to be achieved. Indicators of PFC should be specified in the definition. An example that partially addresses this need is provided in the *Community Watershed Guidebook* (1995): "vegetation cover on the stream bank should be at least 85 percent of the amount in the absence of grazing; concentrated trampling should not occupy more than 5 percent of any 100-metre length of stream; etc." Even this wording is ambiguous, however.

Unless the criteria for measuring the indicators that are used to define PFC are clear to all parties, and unless there are minimum standards in place for PFC, it will be difficult to ascertain whether the riparian area is indeed healthy, let alone ensure that riparian health is maintained. Adopting indicator criteria for the Code definition of PFC will enhance the enforcement and compliance with the legislation.

2. A common understanding of PFC

Throughout this investigation, we found that many ranchers do not have a strong understanding of what "proper functioning condition" and "desired riparian plant community" mean. In some cases, they have not been shown examples of healthy riparian areas to help them recognize what elements of riparian ecosystems are being damaged.

Changes to land management are enhanced by informed decisions that are supported by a foundation of ecological awareness. Field days, training courses, and demonstration sites are all effective tools that can improve understanding of the ecology and management of riparian ecosystems. The Ministry of Forests' Range Branch has pamphlets and a training course on this topic, but there is a lack of extension. These tools could significantly improve the utility of the words "proper functioning condition" in the range use plan.

3. A risk-based approach to monitoring PFC

Monitoring riparian health requires maps that show the location of riparian areas and their relative sensitivity to disturbance. The detail shown in the range use maps varies between districts, but most show the location of lakes, wetlands and streams in each pasture. There is no classification of riparian features, however, on any range use map. It is clear that certain riparian types are significantly more sensitive than others, through a combination of vegetation type, ease of access, soil type and relative availability of alternate water. For example, low-gradient streams in grassland habitat units within the IDF are much more likely to be impacted than incised streams in closed forest. These sensitive sites are predictable and mappable from basic information on contour maps and aerial photos. Sensitive sites are a small proportion of the overall stream network.

The mapped sensitive riparian features can form the basis for riparian inspections, by providing a manageable number of sites for the district range officers to inspect, while also serving as benchmarks of riparian condition in the pasture.

These sites should be identified on a map in the range use plan. If the benchmark sites are doing well, then there can be a fair degree of confidence that the rest of the riparian sites are doing well also.

4. Grazing schedules as a means of managing for PFC

The range use plan specifies a grazing schedule for each pasture. The grazing schedule lists turnout and gathering dates as well as the number of cattle and animal-unit months for the grazing period. Usually, minor adjustments of up to seven days are permitted. The grazing schedule is for a 1- to 10-year period, which is usually the length of the term of the range use plan. There are often provisions in the range use plan for deviation from the prescribed dates if range readiness standards are met. These provisions are generally used for extending the grazing period, but may also be used for shortening it.

As a riparian management tool, the grazing schedule has some limitations. First, adjustments to the grazing schedule because of very dry weather does not appear to be highly proactive. Second, the grazing schedule is based on the expected forage production of the uplands, however in dry years the riparian vegetation may be the main forage in the pasture. Where maintenance of riparian values is a priority, the range use plan grazing schedules should be determined on the basis of riparian sensitivity rather than forage capacity of the uplands. Furthermore, target utilization objectives in the range use plan should be stated specifically for riparian areas. Some districts already use utilization override provisions to the grazing schedule in their more recent range use plans, but others don't.

Riparian management in community watersheds

A higher level of water quality and riparian management is expected in community watersheds. The results from this survey, while of a limited sample size, indicate that riparian health in community watersheds is better than in non-community watersheds. Both average riparian health and the percentage of sites at PFC were higher and the number of cattle faeces was lower in community watershed sites.

It was not apparent why the riparian condition was better in community watersheds, but contributing factors might include:

- The Code requires range tenure holders to identify when a pasture is in a community watershed. The range use plans identified the pastures located in community watersheds, but did not contain maps showing the community watershed boundaries.
- The community watershed pastures tended to be in the higher-elevation, moist forested areas, which typically had a lower level of impact.
- There is more careful management of community watershed pastures because ranchers are aware of water quality concerns in these areas.
- The two districts stated that their levels of field inspections are higher in community watersheds.
- The *Range Practices Regulation* prohibits practices that result in damage to riparian areas in community watersheds.

On the other hand, stocking rates and range developments did not appear to be a factor:

- Special riparian protection developments, such as fencing of sensitive riparian areas, were only observed in one watershed.
- Stocking rates appear to be similar in community and non-community watershed areas.

Commentary

Implications for the results-based code

The Forest Practices Code is being substantially revised to move to a more results-based approach to regulating activities on Crown forest and range lands. While the current model of regulating range practices can be described as results-based, there will still be significant changes in roles and responsibilities. Up to now, the Ministry of Forests has taken a very strong role in both setting objectives and measures for range practices and incorporating those measures into range use plans on behalf of range tenure holders. The changes to the Code may download much of the responsibility for identifying measures, preparing plans and ensuring achievement of results to the range tenure holders. The reduction in ministry resources could also remove much of the assistance that has been available to range tenure holders to ensure they meet Code requirements. The approach of range staff helping ranchers to meet expectations and improve their practices is likely to be replaced with clear performance standards and penalties for non-compliance.

This project has shown that there currently are significant problems in meeting proper functioning condition in riparian areas in a percentage of the pastures. There is also significant variance in the level of understanding of what proper functioning condition is among the range tenure holders. Extension and training will be necessary. The BC Cattlemens' Association, the Professional Agrologists' Association and the ranching industry will have an important role to play in ensuring objectives and standards are clear, measurable and well understood and that the industry is capable of achieving the intended results on Crown range lands. The establishment of a *Drinking Water Protection Act* and potential shifting of liability to tenure holders will further complicate ranchers' responsibilities to manage their cattle in a sound manner.

Comparison of riparian health between districts

The riparian health results show marked differences between the four districts in scores for the individual indicators, in overall average riparian health and in the proportion of sites that do not meet criteria for proper functioning condition. Cranbrook scored the lowest in 5 of the 10 indicators, lowest in overall riparian health and had the largest proportion of non-PFC sites (50 percent). Horsefly district, by contrast scored the best in all categories.

The reason for these marked contrasts in results was due to differences in climate, vegetation type, abundance of streams and lakes, pasture size and numbers of cattle in the pastures. In the year of the survey, Cranbrook experienced only 60 percent of its normal precipitation, the second lowest in 20 years. Consequently, forage production in the uplands was poor and put increased pressure on the riparian forage areas. The dominant forest type in Cranbrook is open Douglas fir forest, which presents few impediments to cattle access around riparian areas, whereas in Horsefly most of the riparian areas are in dense spruce forest, which is avoided by cattle. Cranbrook pastures often had only a few streams or wetlands, while Horsefly had a much higher density of riparian areas, so the

utilization of individual areas was less. Cranbrook has also had a significant loss of grasslands over the last 30 years due to encroachment of forest as a result of fire suppression, which puts pressure on the remaining grazing areas. Elk and deer populations have increased significantly in Cranbrook in recent years, resulting in range competition with cattle and additional impact to riparian areas.

In short, range management in Cranbrook has more challenges than Horsefly. We did not observe any differences in range management practices between districts that would account for the differences in riparian health results.

Riparian health on private land and grazing leases

This survey was of Crown rangeland and did not include private grazing land or grazing leases, which are not subject to the Forest Practices Code. Approximately 80 percent of the grasslands (bunchgrass and ponderosa pine biogeoclimatic zones) in the province are on private land or grazing leases. As a result, this survey included only a small number of sites in grassland areas. Not withstanding the small sample size, the riparian assessments indicate these dry ecosystems are the most sensitive to cattle grazing and scored the highest proportion of sites not meeting proper functioning condition. If these results are extrapolated to private land, it suggests that riparian areas in private land and grazing lease grassland areas of the province may also be at risk.

Relationship of range-impacted riparian sites to forest development areas

In the course of completing fieldwork for this project, some observations were made about the relationship between forest road and cutblock development, and livestock impact on riparian areas.

Cattle use roads extensively for access to the pasture and for grazing roadsides. The effect is to funnel cattle to road stream crossings, which become permanent watering sites. In nearly all cases where a road crosses a stream, there will be point impacts on the stream, extending for up to 10 metres upstream of the culvert. The point impacts are normally physical disturbance of the stream channel (bank disturbance, pugging and stream bed disturbance) and rarely include riparian vegetation degradation. In other words, the cattle are drinking, but not loitering in or grazing these sites.

Our survey did not include this type of disturbance, as we always started a transect at least 50 metres away from the road. The reason is this type of point impact is not typical of the stream reach, being restricted to such a small area. It is a highly visible type of channel disturbance being adjacent to the road, and gives the impression of widespread riparian damage. There is little significant impact on the riparian resource; however there may be a downstream water quality concern.

Integrating range use into the initial design and construction of the stream crossing could largely eliminate this impact. Laying a gravel apron for five metres upstream of the culvert, during road construction, would provide cattle with a preferred accessible drinking point and would eliminate the stream bank churning typical of these sites.

Observations were also made about cutblock leave strips and riparian impact by cattle. Cattle prefer to graze cutblocks for the early seral forage available and the ease of access. In the wetter subzones (ESSF, ICH), cutblock and roadside grazing provides the only significant grazing opportunity. Riparian health, as affected by livestock, was found to be better in forested areas as compared to cleared areas. Also, cutblocks with riparian leave strips were in better health than cutblocks with no riparian leave strips. Furthermore, the number of riparian sites that were functional at risk or non-functional is higher in cutblocks with no reserves. Cattle appear to be averse to walking through

closed forest to access streams or lake/wetlands. A riparian leave strip, even 10 to 15 metres wide, reduces riparian impact and could be prescribed in cutblocks with riparian or water quality concerns.

Recommendations

In accordance with section 185 of the *Forest Practices Code of British Columbia Act*, the Board makes the following recommendations:

1. Proper functioning condition should be better defined in the Forest Practices Code. Criteria for PFC, including both targets and minimums, should be developed so it can be unambiguously measured and can be objectively audited. A list of standardized criteria for PFC could be included as a template in all range use plans. This template needs to be sensitive to local variances. Riparian objectives and proper functioning condition needs to be fully understood by all range tenure holders.
2. As the regulatory regime moves to a full results-based approach, enforcement will become even more important and the roles and responsibilities of the range licensee and the Ministry of Forests should be clarified. Recent amendments to the *Operational Planning Regulation* (2000) go one step toward disentangling the ministry from the process of both preparing range use plans and approving them. Further work is needed to distinguish what the ministry role is: compliance and enforcement; or mentor and collaborator in range management.
3. Amend section 7(3) of the *Range Practices Regulation*, which currently applies only to community watersheds, so that it protects all riparian areas. Specify clear measurables in the regulation for limits on soil disturbance, channel disturbance and faecal deposition. Acceptable limits should be specified in the regulation rather than leaving these limits up to the discretion of the district manager.
4. Amend the definition of "riparian area" in the *Operational Planning Regulation* and the *Range Practices Regulation* to include a specified minimum width that applies only in those situations where there is no distinct riparian vegetation boundary around the stream or lake. A significant percentage of streams and lakes do not have a distinct riparian vegetation band, and under current legislation are not protected.
5. A riparian classification system for rangelands should be adopted, as currently there is none. The classification system will provide a framework for identification of sensitive riparian areas, for monitoring key areas for compliance and for adaptive management trials.

In accordance with section 186 of the Act, the Board requests that the Ministry of Forests advise the Board of how these recommendations are addressed in the new results-based regime for range practices by September 30, 2002.

Appendix 1 – Indicator Results

Riparian health indicators

Ten indicators were used to assess the health, or proper functioning condition, of the riparian areas. The overall distribution of values recorded in the field for the indicator is summarized in a pie chart followed by a table. The percentage occurrence of values for that indicator that are below the functional at risk (FR) or non-functional (NF) threshold (see Table 1) is shown as a bar graph for each district.

Indicator 1: Vegetative cover

Vegetative cover of less than 75 percent is considered an FR threshold for riparian function. Overall, 88 percent of the sites scored over 75 percent vegetative cover with 14 percent of wetlands and 8 percent of streams having cover of less than 75 percent (Figure A-1).

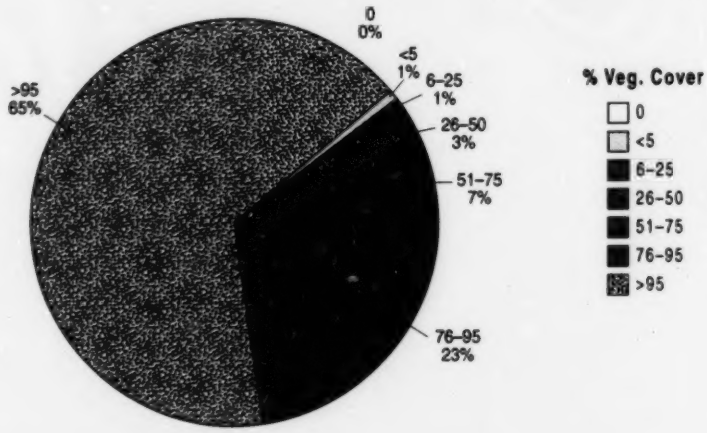

Figure A1. Percentage of sites in total vegetative cover classes.

Approximately 14 percent of Kamloops and Penticton and 24 percent of Cranbrook wetland/lake sites had cover of less than 75 percent (Figure A2). Horsefly, by contrast, had none.

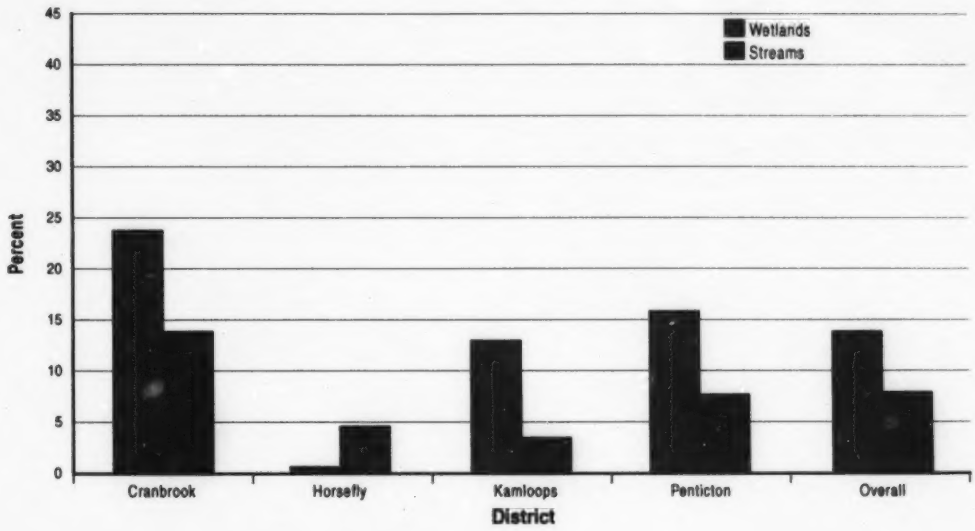

Figure A2. Percent of features with vegetative cover less than 75%.

Indicator 2: Livestock-caused bare ground

Soil disturbance in excess of five percent is considered an FR threshold and in excess of 10 percent is considered NF. A total of 81 percent of the sites sampled had less than five percent livestock-caused bare ground and 90 percent had less than 10 percent bare ground (Figure A3). No bare ground was found on 50 percent of the sites surveyed.

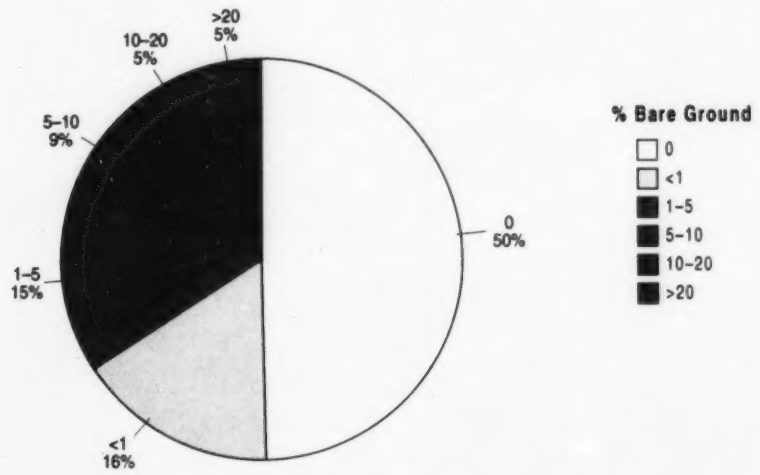

Figure A3. Overall percentage of sites with livestock-caused bare ground.

Overall, 23 percent of the wetland/lake sites had soil disturbance in excess of 5 percent (Figure A4). The highest level of FR soil disturbance in wetlands was Cranbrook (41 percent of sites) and Kamloops (31 percent of sites). On streams, 16 percent of overall sites had soil disturbance in excess of 5 percent, but Cranbrook streams had 35 percent of its sites disturbed over 5 percent. In Cranbrook, high ungulate numbers no doubt contributed to some of the recorded soil disturbance.

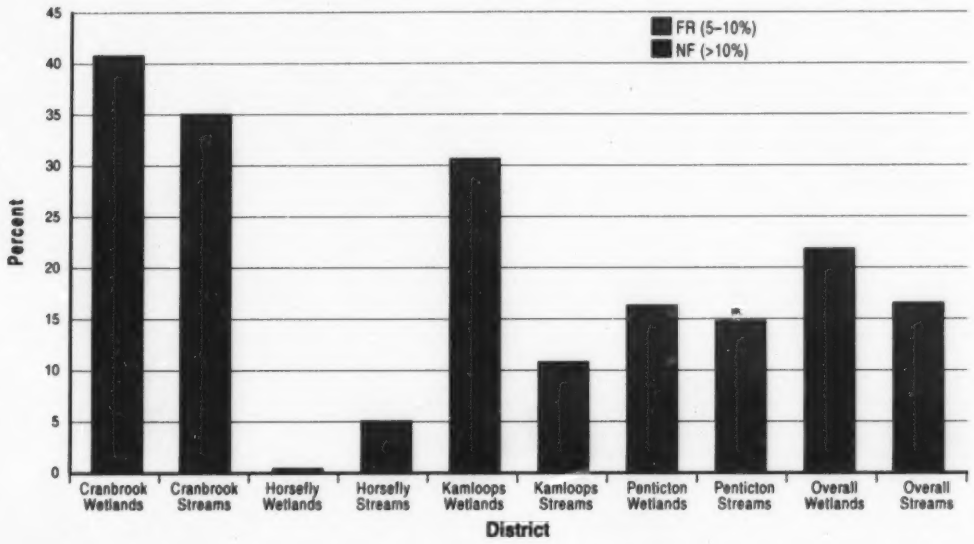

Figure A4. Percentage of sites with >5% and >10% livestock-caused bare ground.

Indicator 3: Noxious weeds

Overall cover of noxious weeds was low in the riparian areas. For all sites combined, 75 percent of the sites had zero percent cover of noxious weeds and 2 percent of the sites had over 5 percent cover of noxious weeds (Figure A5). Values more than 5 percent are considered an FR threshold for noxious weed cover, and values in excess of 20 percent are considered NF.

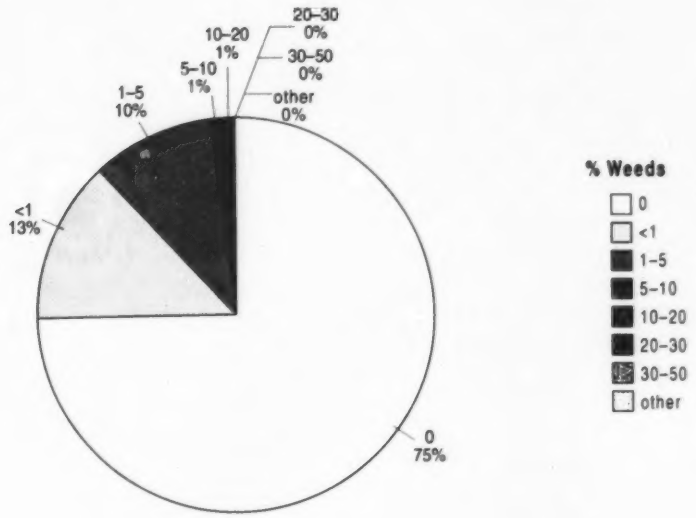

Figure A5. Overall percentage of sites with noxious weeds.

Sites with greater than 5 percent cover of noxious weeds occurred only in lakes/wetlands (Figure A6), where 7 percent of Penticton and Cranbrook wetlands and 4 percent of Horsefly wetlands were affected. No cases of noxious weed cover in riparian zones in excess of 20 percent were recorded in any district.

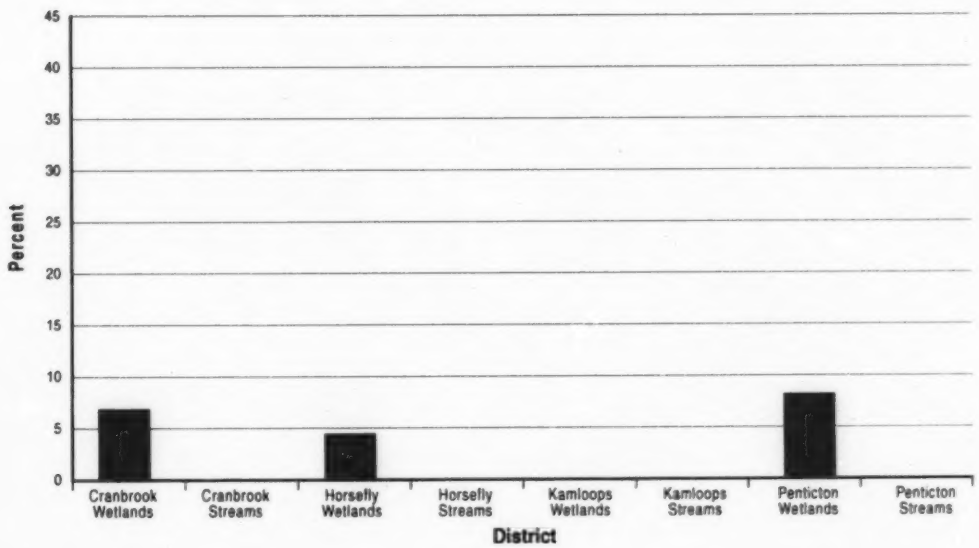

Figure A6. Percentage of sites with >5% cover of noxious weeds.

This result should be interpreted with some caution. Noxious weed problems are serious in parts of these districts, and because of limited sample size and the non-random nature of weed distribution, our riparian survey does not characterize the overall distribution of weeds across the district.

Indicator: Increaser-invader species

Overall, 60 percent of the sites had zero percent increaser-invader species presence (Figure A7). Eighty-six percent of the sites had less than 5 percent increaser-invader species. Values more than 25 percent are considered an FR threshold for cover of increaser-invader species. Overall, 7 percent of the sites exceeded this value.

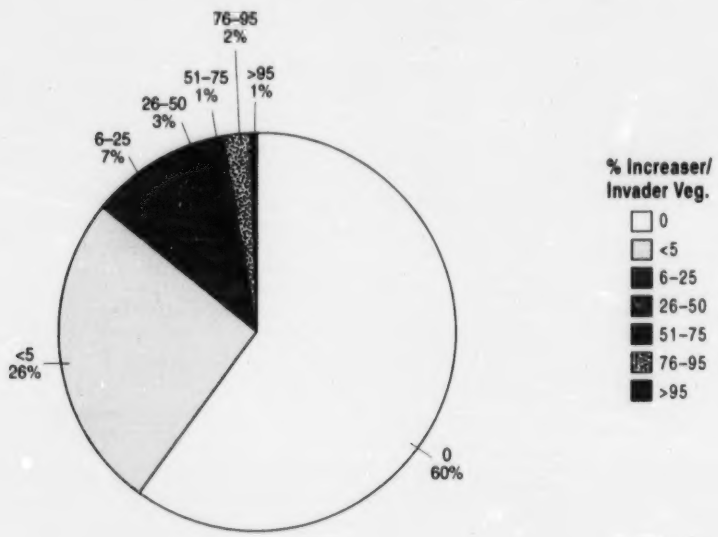

Figure A7. Overall percentage of sites with increaser-invader species.

The number of sites with levels of increaser-invader species in excess of the FR threshold of 25 percent varied significantly by district (Figure A8). Over 26 percent of Kamloops wetlands and 18 percent of Cranbrook wetlands had levels in excess of 25 percent cover.

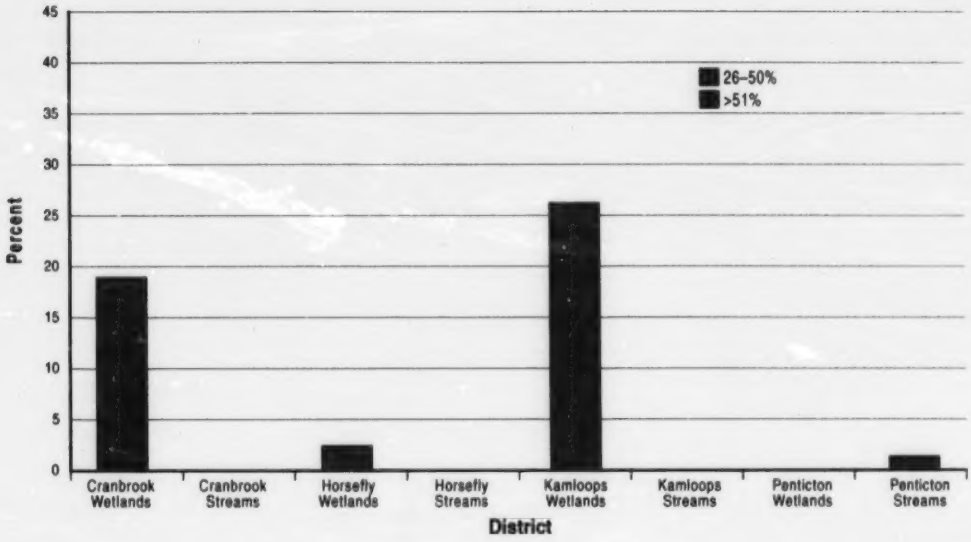

Figure A8. Percentage of sites with >25% increaser-invader species cover.

Indicator 5: Browsing of shrubs

Overall, 59 percent of the sites had second year browse levels of less than 5 percent (Figure A9) and 87 percent of the sites had less than 25 percent. Browse use in excess of 25 percent is considered a FR threshold. Thirteen percent of the sites exceeded this value.

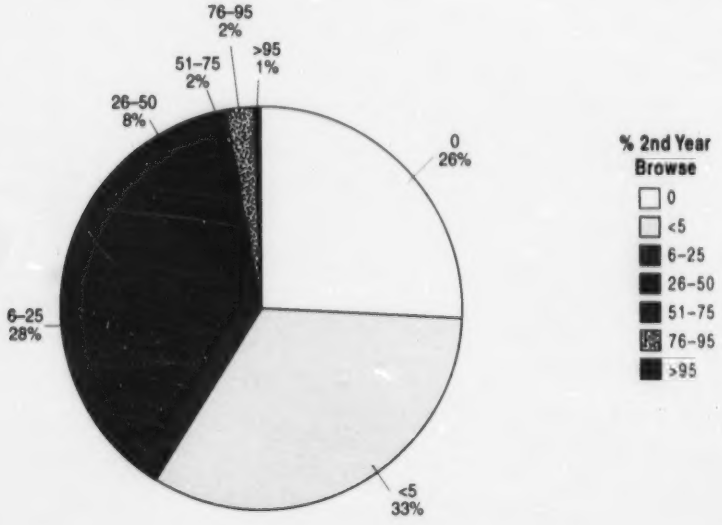

Figure A9. Overall percentage of sites with second year browse.

Penticton wetlands exceeded the 25 percent (FR) threshold on 17 percent of the sites (Figure A10). Kamloops had the highest number of streams with FR browse (11 percent of the sites). Cranbrook, in spite of its large ungulate populations, had few sites with browse in excess of 25 percent.

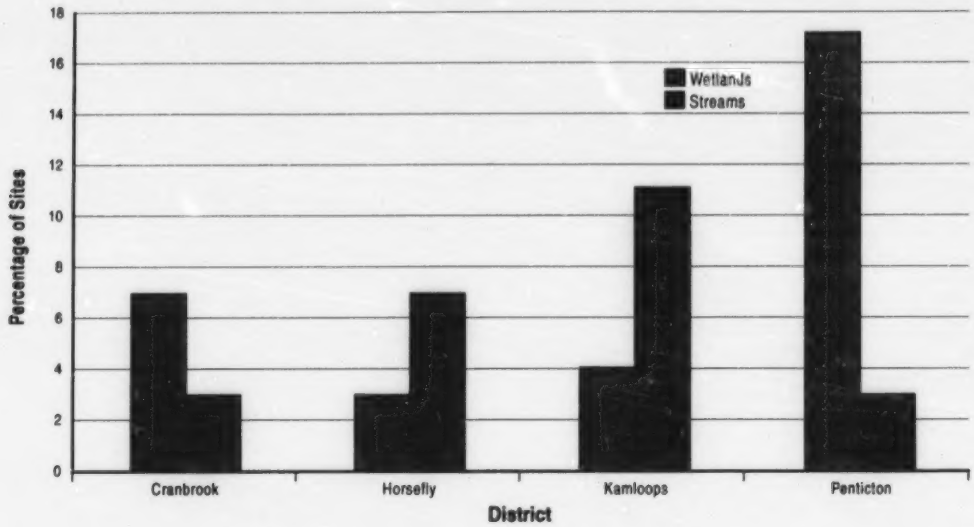

Figure A10. Percentage of sites with >25% browse levels.

Indicator 6: Deep-rooted stream bank vegetation

Values less than 65 percent are considered a FR threshold for adequate cover of deep-rooted vegetation and values less than 35 percent are considered non-functional. Overall, 82 percent of the sites had greater than 65 percent deep-rooted vegetation, and 66 percent of the sites had greater than 85 percent deep-rooted vegetation. Eighteen percent of the sites had less than 65 percent deep-rooted vegetation and 10 percent of the sites had less than 35 percent (Figure A11).

Overall, 19 percent of wetlands and 17 percent of streams did not meet FR or NF thresholds. In Cranbrook, 18 percent of wetlands and streams had values less than 35 percent (NF), with an additional 20 percent of streams with values between 35 to 65 percent (FR)(Figure A12). Twenty-two percent of Kamloops wetlands also had values less than 35 percent cover.

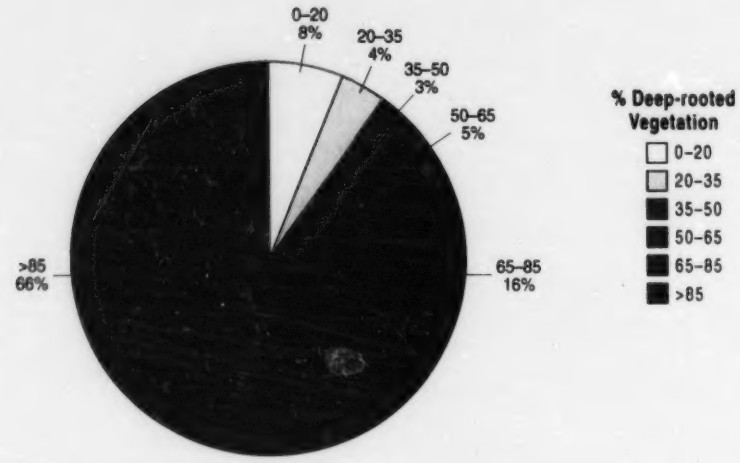

Figure A11. Overall percentage of sites with deep-rooted stream bank vegetation.

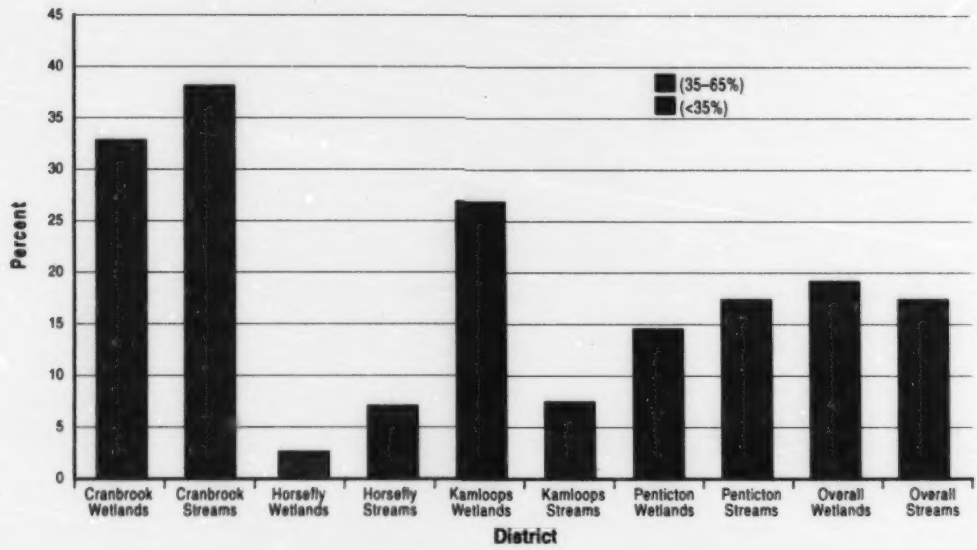

Figure A12. Percentage of sites with <35% deep-rooted stream bank vegetation cover.

Indicator 7: Stream banks or shoreline disturbance

Values in excess of 15 percent stream bank/shoreline disturbance are considered a FR threshold for this indicator and in excess of 35 percent an NF threshold. Overall, 91 percent of the sites had less than 15 percent stream bank/shoreline disturbance (Figure A13). Sixty-four percent of all sites had zero stream bank disturbances. Overall, 3 percent of the sites had stream bank/shoreline disturbance in excess of 35 percent.

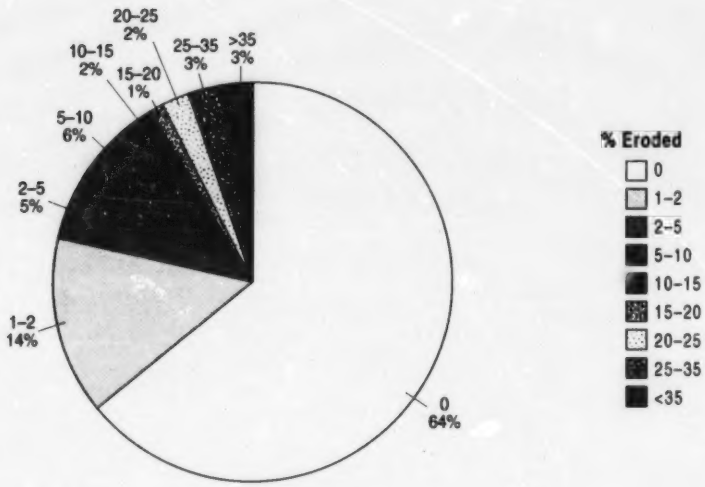

Figure A13. Overall percentage of stream banks/shoreline disturbance by livestock.

In Cranbrook district, 23 percent of the streams and 13 percent of the wetlands had more than 15 percent stream bank/shoreline disturbance, with a significant portion in excess of 35 percent disturbance (Figure A14). Eight percent of Penticton streams and wetlands had stream bank/shoreline disturbance in excess of 15 percent. Horsefly and Kamloops had relatively few high stream bank/shoreline disturbance sites, with no sites in excess of the 35 percent disturbance level.

Indicator 8: Channel bed disturbance

Overall, 70 percent of the sites had zero percent channel bed disturbance (Figure A15). A value of 15 percent is considered an FR threshold for channel bed disturbance and disturbance greater than 35 percent is considered non-functional. Overall, 4 percent of the sites had channel bed disturbance in excess of 35 percent. Ninety-two percent of all stream sites had less than 15 percent channel bed disturbance.

Eighteen percent of Cranbrook streams had channel bed disturbance in excess of the FR threshold of 15 percent (Figure A16). Both Kamloops and Penticton had 7 percent of their streams in excess of this threshold.

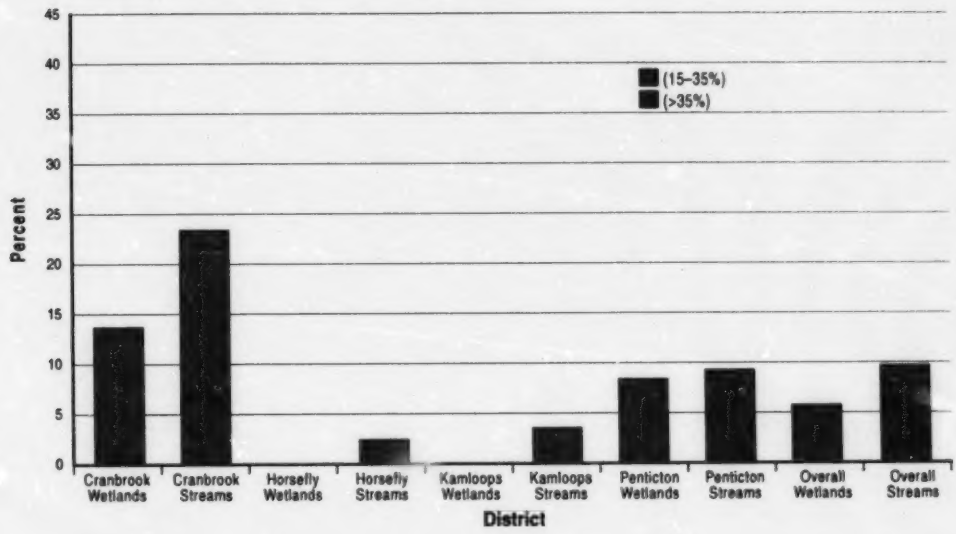

Figure A14. Percentage of sites with >15% and >35% stream banks/shorelines disturbance by livestock.

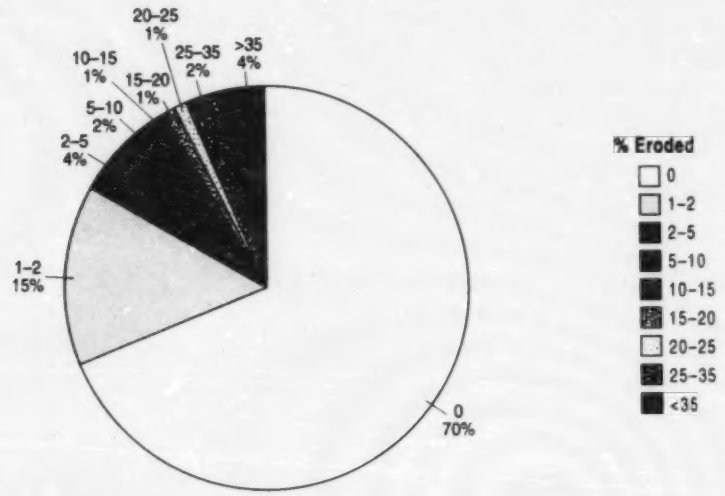

Figure A15. Overall percentage of sites with channel bed disturbance by livestock.

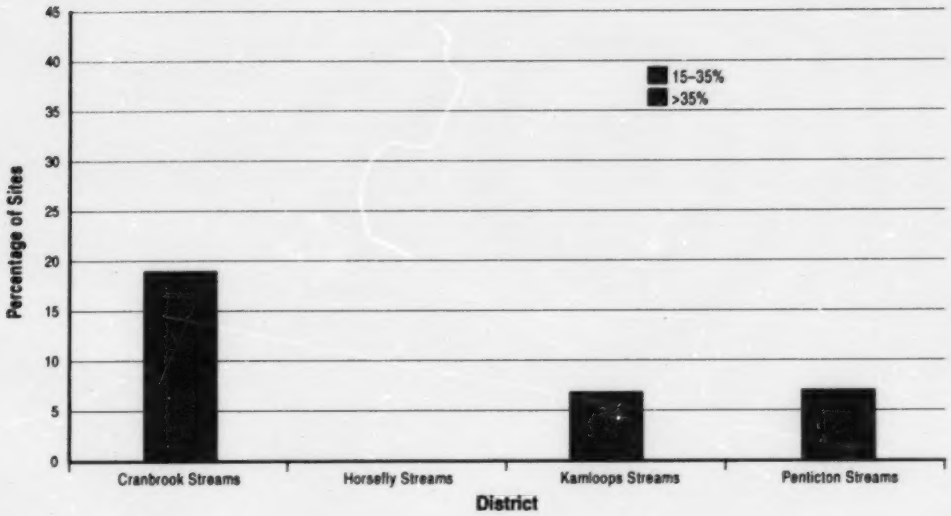

Figure A16. Percentage of sites with >15% and >35% channel bed disturbance.

Indicator 9: Pugging and Hummocking

Forty-five percent of the sites had less than 1 percent disturbance from pugging and hummocking (Figure A17) and an additional 25 percent of the sites had 1 to 5 percent pugging and hummocking.

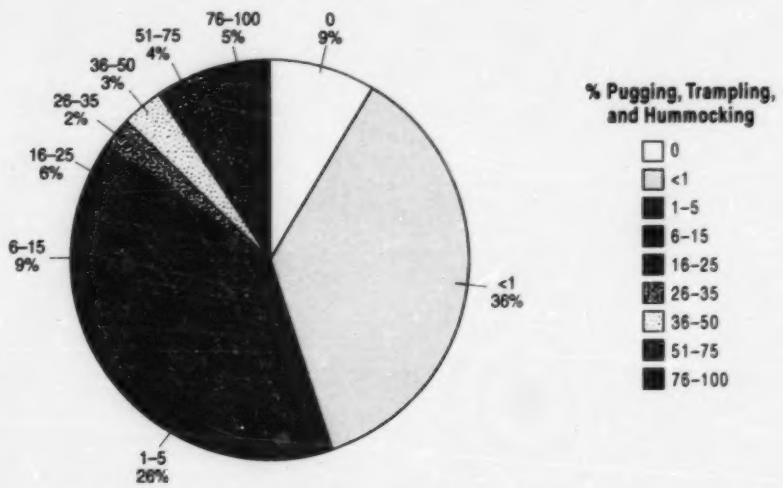

Figure A17. Overall percentage of sites with disturbances from pugging and hummocking.

Pugging and hummocking in excess of 15 percent is considered an FR threshold and greater than 25 percent is considered NF. Overall, 20 percent of the sites exceeded the 15 percent threshold.

By district, 46 percent of Cranbrook wetlands and 52 percent of Kamloops wetlands exceed the 15 percent threshold (Figure A18). Twenty-one percent of Cranbrook streams and 13 percent of Kamloops streams also exceeded this threshold.

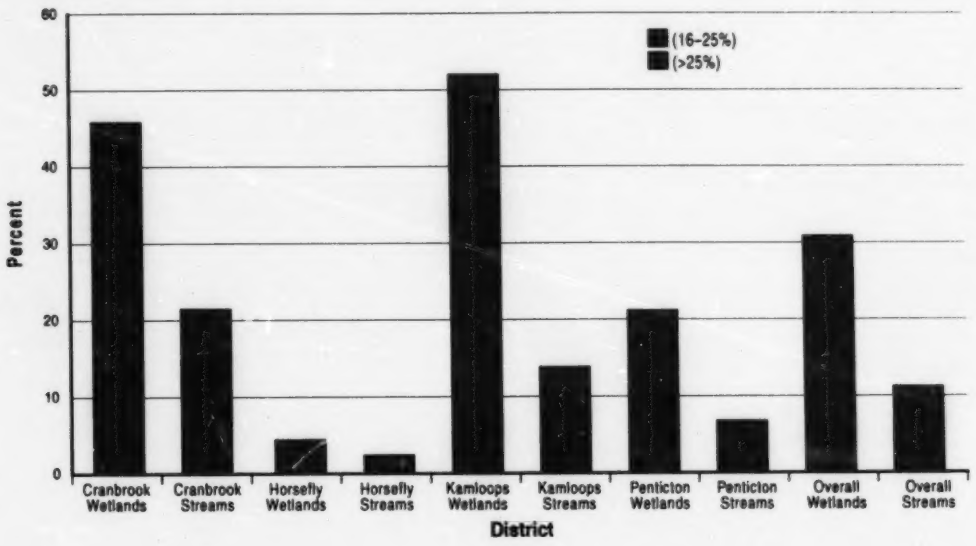

Figure A18. Percentage of sites with >15% and >25% pugging and hummocking.

Indicator 10: Upland condition

Very few sites had uplands with significant erosion potential. Overall, 98 percent of the sites had no erosion hazard in the uplands. In Cranbrook, 7 percent of the wetland uplands and 3 percent of the stream uplands were considered a potential hazard (Figure A19). In Penticton, 3 percent of the wetland uplands and 4 percent of the stream uplands were a potential hazard.

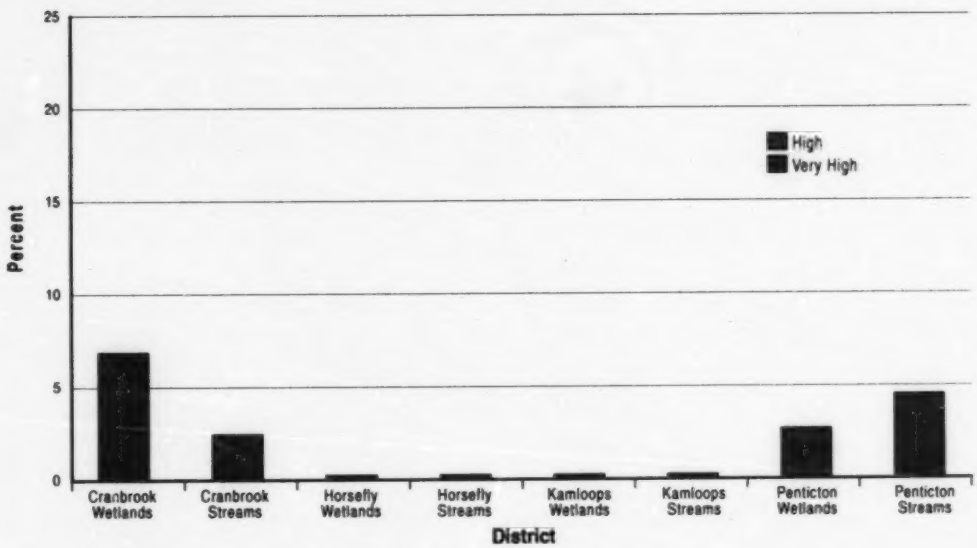

Figure A19. Percentage of sites with erosion problems in the uplands.

Appendix 2 – Cattle Faeces Counts

Cattle faeces counts were made on one side of the stream, or along the shoreline, in a 3-metre-wide band from the edge of the high-water mark, for a distance of 100 metres. The graph is the average cattle faeces count for streams or lakes/wetlands in each district.

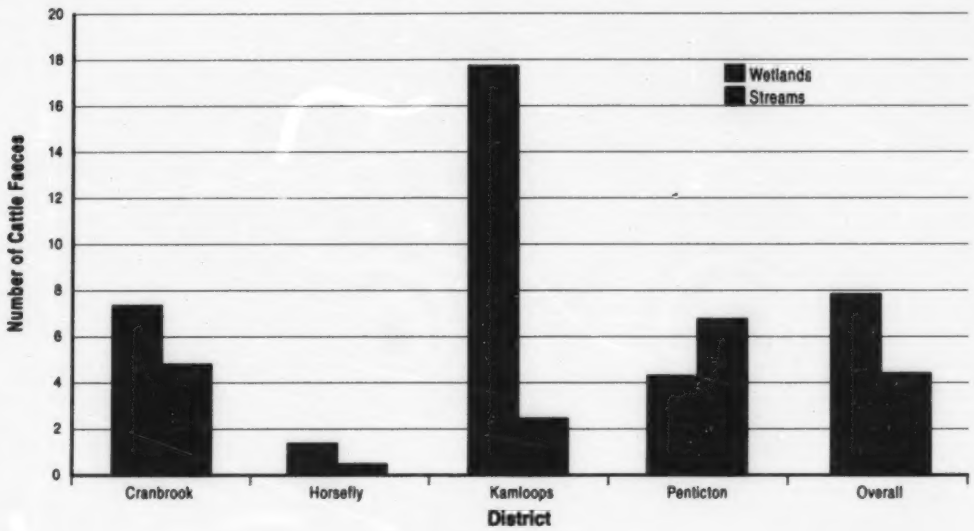

Figure A20. Average number of cattle faeces in a 3 × 100 m band.

Appendix 3 – MOF Methodology for Determining Proper Functioning Condition

A second PFC evaluation method was used in this study for comparison. The Ministry of Forests' PFC checklist method asks 20 questions about riparian characteristics that are answered "Yes" or "No." The emphasis is on the end condition of the stream channel or wetland, without corresponding questions about the role that livestock may have had in that condition. The procedure does not collect data on the factors that contribute to riparian health (for example percent deep-rooted vegetation), just the end result (for example, overhanging stream bank). The questions in the PFC checklist are qualitative, for example: Are nutrient levels normal? In spite of the differences from the method used in this project, the results do give a picture of overall riparian condition and make for a useful second opinion to compare to our main assessment method.

The PFC checklist lists 18 questions, answered "Yes," "No" or "N/A." The number of "Yes" scores is tabulated and the reach is rated according to the following table:

% of Yes answers	Rating
>80%	PFC
20% <Yes<80%	At risk
<20%	Non-functional

Overall, 78 percent of the sites scored PFC, 18 percent were at risk and 4 percent were non-functional. There are significant differences between districts, however. Cranbrook wetlands have the lowest number of PFC sites (55 percent) as well as the highest number of NF sites (13 percent). Horsefly wetlands, by contrast, had 100 percent of the sites at PFC.

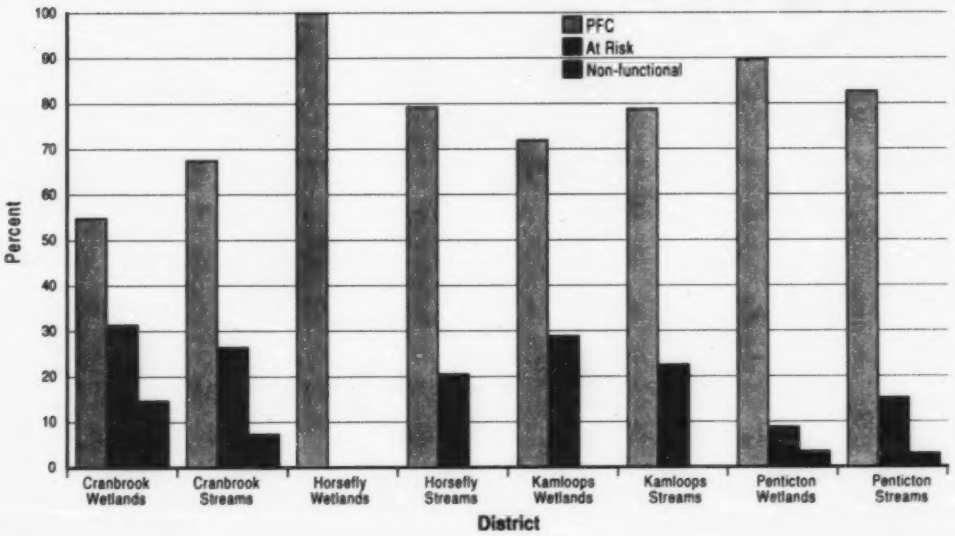

Figure A21. Percent area PFC/at risk/non-functional.

Appendix 4 – Glossary of Terms

Animal-unit month: The amount of dry forage required by one animal unit for one month. The animal unit is usually defined as a 450-kg cow with calf.

Bare ground: All land surface not covered by vegetation, rock, or litter.

Bare mineral soil: Same as bare ground.

Biogeoclimatic zone: The broadest unit of the Biogeoclimatic Ecosystem Classification. Zones are broad vegetation complexes reflecting the same regional climate.

Bog: A class of wetland characterized by a thick layer of sphagnum-based peat. It receives its water primarily from direct precipitation. The waters are acidic and nutrient-poor.

Browse: That part of leaf and twig growth of shrubs, woody vines, and trees available for animal consumption, or, the act of consuming browse.

Canopy cover: The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. It may exceed 100 percent.

Channel: The stream banks and stream bed formed by fluvial processes.

Channel bed: The bottom of the stream below the usual water surface. Beds contain sediments deposited by moving water such as rocks, sands, gravels and fine materials.

Community watershed: The drainage area above the most downstream point of diversion on a stream for a water use that is for human consumption and that is licensed under the *Water Act* for (i) a waterworks purpose, or (ii) a domestic purpose if the licence is held by or is subject to the control of a water users' community incorporated under the *Water Act.*

Crown range: Crown land included within the boundaries of a range district, but does not include Crown land that is subject to a lease issued under the *Land Act.*

Cutblock: An area of forestland from which all merchantable trees have been recently harvested.

Desired plant community: A plant community that produces the kind, proportion and amount of vegetation necessary for meeting or exceeding the land use plan or activity objectives established for an ecological site.

Ephemeral drainage: An area of land where water drains away for brief, transient periods following an influx of moisture such as from localized snowmelt or heavy precipitation.

Exclosure: An area fenced to exclude animals.

Fen: Wetlands with organic soils and a water table near the surface. Soils are decomposed sedge and non-sphagnum moss peats. Waters are near neutral in pH and are nutrient rich. Vegetation is primarily sedges, grasses and reeds but some shrubs and scattered trees may occur.

Floodplain: Lowlands adjoining streams; frequently flooded during spring freshets or extreme rainfall events.

Fluvial: Pertaining to, or produced by, the action of a stream or river.

Forage: Browse and herbage that is available and may provide food for grazing animals.

Forage utilization: The proportion of current year's forage or browse production that is consumed by grazing animals.

Forest resources: Resources and values associated with forests and range including timber, water, wildlife, fisheries, recreation, botanical forest products, forage and biological diversity.

Gully: A channel or miniature valley cut by concentrated, non-continuous runoff such as during snowmelt or following heavy rains.

Herbaceous: Non-woody vegetation, such as grasses, sedges, reeds and forbs.

Higher level plan: An objective for a resource management zone, a landscape unit or sensitive area.

Hummocking: Formation of raised mounds of soil in wetlands from trampling by large animals.

Hydrology: The properties, distribution, and circulation of water and snow.

Increaser: Plant species, of the original vegetation, that increase in relative amount due to over-grazing.

Invader: Plant species that were absent in undisturbed portions of the original vegetation of a specific range site and will invade following disturbance or continued heavy grazing.

Leave strip: A strip of trees and vegetation separating a stream, lake or wetland from an adjacent cutblock.

Marsh: Wetlands with mineral soils and fluctuating water levels. Nutrient-rich waters have neutral to basic pH. Cattails, reeds, sedges and grasses form the emergent vegetation.

Noxious weeds: Any weed designated by the *Weed Control Regulations* in the *Weed Control Act* and identified on a Regional District noxious weed control list.

Operational plan: means a forest development plan, logging plan, range use plan, silviculture prescription, stand management prescription and site plan.

Pedestal: A condition where the soil has eroded from around individual plants leaving them on small pedestals of soil. Sometimes results from frost heaving.

Phreatophyte: A deeply-rooted plant deriving its moisture from subsurface sources.

Point disturbance: Any disturbance that is concentrated within a small area, such as at a gate or stream crossing.

Proper functioning condition: The ability of a stream, river, wetland, or lake, and its riparian area, to withstand: normal peak flood events without experiencing accelerated soil loss; channel movement or bank movement; filter runoff; and, store and safely release water (Forest Practices Code definition).

Pugging: Deep hoof prints left by large ungulates on moist, fine-textured soils of streams and wetlands.

Range: Any land supporting vegetation suitable for grazing.

Range land: Crown range and land subject to an agreement under section 18 of the *Range Act*.

Reach: A relatively homogeneous portion of a stream that has a sequence of repeating structural characteristics.

Rill: A small channel created on steep slopes by water erosion.

Riparian area: The banks and adjacent areas of a stream, river, lake or wetland. It contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.

Riparian feature: River, stream, lake or wetland.

Riparian leave strip: An unharvested border of forest around a riparian feature.

Riparian zone: Same as riparian area.

Seep: Wet areas, normally not flowing, arising from an underground water source.

Seral: Refers to species or communities that are eventually replaced by other species or communities through succession.

Shallow open water: A wetland with intermittently or permanently flooded areas where water depth does not exceed two metres. These open waters, commonly called ponds, have little or no emergent vegetation. Soils may be organic or mineral.

Stream: A watercourse formed when water flows either continuously or intermittently between continuous definable channel boundaries. The stream banks may be discontinuous on smaller streams, but the channel is detectable throughout the extent of the reach.

Stream bank: The rising ground bordering a stream channel. Typically extends from the outer edge of the unvegetated channel to 1-to-2 metres into the riparian zone.

Stream bed: The bottom of the stream below the usual water surface.

Stream channel: The stream bed and banks formed by fluvial processes, including deposited organic debris.

Stream reach: see Reach.

Subzone: A unit of the Biogeoclimatic Ecological Classification with less climatic variability and a narrower geographic distribution than the zone. Subzones are distinguished by a unique composition of plant species. They are climatically based and represent precipitation and temperature regimes.

Swamp: A tree or tall-shrub dominated wetland with mineral or occasionally peat soils that experiences periodic flooding and nearly permanent subsurface water flow. The waters are nutrient rich.

Trampling: Treading underfoot; the damage to plants or soil brought about by movements or congestion of animals.

Tenure holder: An individual, group, or company that holds a licence agreement as defined in section 3 of the *Range Act*.

Turnout: Act of turning livestock out on the range at the beginning of the grazing season.

Undesirable plant species: Species that contribute negatively to the management objectives.

Upland: Land elevated above a riparian area.

Utilization: The proportion of current year's forage production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole.

Vegetative cover: The plants or plant parts, living or dead, which protect the ground surface. Cover may also refer to the area of ground cover by plants of one or more species.

Watershed: A total area of land above a given point on a waterway that contributes runoff water to the flow at that point.

Wetlands: Areas characterized by soils that are usually saturated and support mostly water-loving plants.

Wet meadow: A class of wetland having mineral soils which are periodically saturated. Dominant vegetation consists of water-tolerant grasses, sedges, rushes, and forbs.